
NON · OMNIS · MORIAR

IN THE BEGINNING

(LES ORIGINES)

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BY

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TRANSLATED FROM THE FRENCH

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"Melior est causa causæ quam causa causati"

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THIS TRANSLATION IS

DEDICATED

WITH AFFECTIONATE RESPECT

TO

E. VINCENT.

PREFACE TO THE FIRST EDITION

WE shall translate the Author's Preface without changing it in any way, as it shows with what object and under what circumstances this book was undertaken.

This work was written for my pupils at the Seminary of Issy, and to them I dedicate it.

I think it necessary to say this in order to account for the subject of which it treats, and to make the intention understood with which I composed it.

Having to give instructions on Natural Sciences to young philosophers, I found it impossible to confine myself to the experimental and practical part only; it was necessary to go back to first causes, and treat of such questions as the study of nature invariably raises in thoughtful minds.

Speaking to young ecclesiastics, whose mission would be to propagate and to defend the faith, I had to throw light on those points where free-thought, apparently founded on the Natural Sciences, affirms Christian revelation to be lacking.

Materialists have for some time had great weight with the people, because they alone (almost) had strengthened their position by the aid of Science. It is also most essential that the young clerics should be wanting in no knowledge concerning humanity, and that they should be able to give incontestable proof of their competence, both in order to obtain a hearing when they speak, and also that they may learn to speak with accuracy and power. Not only have they nothing to lose in the study of human sciences, but their Apostolic Ministry will benefit by the earnest endeavours they have made to inform themselves on these matters. Science is not the exclusive right of one particular school of thought; it renders up its secrets to those who study it with care. It is by a mistaken construction that it is made to serve the ends of

materialism and atheism. In causing it to add its testimony to the glories of the Author of Nature, learned Catholics would make Science forward its legitimate object.

A perusal of the table of contents will suffice to convince the reader that the seven subjects under discussion indicate those which chiefly engage the attention of humanity at the present time. I am far from having exhausted the numerous questions which natural history raises, it is enough to have touched the chief ones.

My object has not been to compile a work of exegesis, nor to expound the dogmata of religion; my intention was only to furnish theologians and exegetists with scientific data, without which they would find it difficult to give a correct interpretation of texts dealing with psychical and physical origins.

This volume has no scientific pretensions. Were it judged with the utmost rigour, it would not disturb me.

To make a work of true scientific value, it would have been necessary to devote a separate volume to each subject. I have inserted in these pages such information as my pupils required for their instruction, and which it was impossible for me to give them *vivâ voce* with any completeness; I hope that I have been accurate and clear.

My great desire has been always to keep before me the requirements of my pupils. It is of the utmost importance to consider the capabilities of those to be taught. Two perils of equal danger have to be avoided: an ill-founded compliance with the theories in favour amongst the learned; and a blind attachment to certain ideas which have no firm foundations, but which some men erroneously consider as identical with the faith.

In order to maintain the *via media* which truth frequents, I imposed on myself the three following obligations:—

1. *Honestly explain systems*, even those which I have to oppose. By this means I avoided for my pupils the shock of meeting, at a future time, a clearer and better exposition of the matter; it also led them to listen to and value my reasoning.

2. *Assert with firmness what is well established.*—Science, when well understood, does not confine itself to producing problems; it resolves many, and those the most important. With the help

of religious faith it shows us God creating the world; God establishing laws of order in the world; God creating life; God creating man; it teaches us the unity of the human species, the absolutely human condition of primitive man. . . . These are the essential points on which the believers desire to be reassured.

3. *Leave the questions open which have not yet received a solution.*—Amongst others I will instance that of the origin of species, and that of the antiquity of man. If there are excesses which have to be restrained, it is also true that there are many things of which we are ignorant. These especially call for that moderation and courtesy which I have endeavoured always to preserve.

If I had only written for my pupils, I should no doubt have restricted myself to a more didactic style. But the desire of reaching other readers, to whom scientific knowledge might also be useful, has caused me to use a more ample method and a freer manner.

In conclusion, I am anxious to announce myself as holding firmly to the light which Science affords, and to the teaching of the Faith. If, as Science advances, it should illuminate some doubtful point, or show the fallacy of some solution which I had looked upon as finally settled, I should not hesitate to yield myself to these indications. And if the Church, in whose infallibility I firmly believe, should deliver a judgment contrary to my assertions, I am ready, in advance, to accept her teaching.

PREFACE TO THE SECOND EDITION

In publishing a Second Edition of my book, I shall make no change in the preceding lines. Although I have quitted my dear pupils of Issy, this book belongs to them always; their eager questions acted as a stimulus which spurred me on to study; it was to satisfy their desires that I wrote.

This edition differs in no essential particular from the preceding one. Certain kindly meant criticisms have induced me to make useful alterations; some propositions I have defined more clearly, and I have elucidated passages by notes which might otherwise

have been obscure; numerous engravings will spare the reader the effort of imagination; I have availed myself of any fresh scientific knowledge, whether the result of the progress of thought or of recent discoveries. The chapter on Primitive Man is the one that has undergone the greatest alterations.

I am conscious of having brought the most absolute sincerity to bear on all these questions, some of which are much discussed. I neglected nothing which could add to my information, and then made it plain towards which opinion my studies had inclined me. Not only are these scientific deductions in no way contrary to the Faith, but they seem to me to add security even to the Faith itself.

Many readers will perhaps regret that in the exposition of these problems, I have not used more rhetorical force and a more trenchant tone. Since there is no lack of books written after this manner, it seemed to me better and more useful to give a calm and scientific character to the work. May my efforts advance the cause of the much loved Church.

1898.

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IN THE BEGINNING

CHAPTER I

COSMOGONY, OR THE ORIGIN OF THE UNIVERSE

Cosmogony is the history of the formation of the Universe. Sometimes the word is used to express the combination of phases through which the visible world has passed from the moment of its first creation to our day; at other times it is applied to one particular phase, such as the formation of the earth, or the production of life.

All peoples—at all times—have had their cosmogonies or their own conception of the origin of things. These cosmogonies, at first infantine and rude in conception, when made by primitive races and savage tribes of modern times, became day by day more rational and enlightened as science developed.

It may be said, in a general way, that from all time, man has studied the problem of the origin of things; that he has always manifested anxiety to solve it, and that at each epoch his decision has been aided by the scientific developments of that period. Thus the solution arrived at generally reflects the condition of human science at that time.

The science of our century should also put forward its cosmogony, and as the knowledge of Nature has immensely increased during the last hundred years, we should be in a more enlightened condition than our predecessors with regard to the origin of the Universe.

§ 1. *The Cosmogony of Modern Science.*[1]

The ideas usually accepted by learned men of modern times are not altogether new. They are found in the days of antiquity, and (though somewhat lacking in shape) in the poem of Lucretius.[2] With Descartes it assumes a scientific form.[3]

[1] See Kant, *La Théorie du ciel*, M. Wolf's translation, in the *Hypothèses cosmogoniques*, Paris, Gauthier-Villars; Laplace, *Exposition du système du monde.* Œuvres, t. vi. note vii., Paris, 1846; *Introduction à la théorie analytique des probabilités*, t. vii. p. lxi. and following; Faye, *Sur l'Origine du monde*, 1896, Paris, Gauthier-Villars; Wolf, *Les Hypothèses cosmogoniques*, Paris, Gauthier-Villars, 1886.

[2] *De natura rerum.* Lib. V. v. 432. "On ne voyait pas encore dans le ciel le char éclatant du soleil, ni les flambeaux du monde, ni la mer, ni le ciel, ni la Terre, ni l'air, ni rien de semblable aux objets qui nous environnent, mais un ensemble orageux d'éléments confondus. Ensuite quelques parties commencèrent à se dégager de cette masse, les atomes homogènes se rapprochèrent; le monde se développa, ses membres se formèrent, et ses immenses parties furent composées d'atomes de toute espèce." Without being able to formulate a law, Lucretius acknowledges a slow evolution in the formation of the physical world. See the entire quotation in Faye, pp. 76-78, Lagrange's translation.

[3] We take the following beautiful extract of Descartes from M. Faye's work, p. 528: "Permettez pour un peu de temps à notre pensée de sortir de ce monde pour en venir voir un autre tout nouveau, que je ferai naître devant vous dans les espaces imaginaires. . . .

"Entrons si avant dans ces espaces que nous puissions perdre de vue toutes les créatures que Dieu fit il y a cinq ou six mille ans, et, après nous être arrêtés là en quelque lieu déterminé, supposons que Dieu crée autour de nous tant de matière que, de quelque côté que notre imagination se puisse étendre, elle n'y aperçoive plus aucun lieu qui soit vide. Supposons que, de ces matériaux, les uns commencent à se mouvoir d'un côté, les autres d'un autre; les uns plus vite, les autres plus lentement . . ., et qu'ils continuent par après leur mouvement suivant les lois ordinaires de la nature; *car Dieu a si merveilleusement établi ces lois, qu'encore que nous supposions qu'il ne crée rien de plus que ce que j'ai dit, et même qu'il ne mette en ceci aucun ordre ni proportion, mais qu'il en compose un chaos le plus confus et le plus embrouillé que les poètes puissent décrire, elles sont suffisantes pour faire que les parties de ce chaos se démêlent d'elles-mêmes, et se disposent en si bon ordre qu'elles auront la forme d'un monde très parfait, et dans lequel on pourra voir non seulement de la lumière, mais aussi toutes les autres choses, tant générales que particulières, qui paraissent dans ce vrai monde.*" What has been underlined expresses very clearly the basis common to all the modern hypotheses; *i.e.* the formation of the world by a law of evolution.

Kant's ideas approach very closely to those enunciated at the present day.[1]

In France they are generally known by the title *L'hypothèse cosmogonique de Laplace* [2] *et de Faye.*

It is not possible to enter into long technical details here, nor to indicate exactly the part followed by each author; a short summary of the theories of cosmogony at present adopted will therefore be given. We shall divide the history of the world into three parts.

1st. From the Creation to the formation of the earth.

2nd. From the formation of the earth to the appearance of Man.

3rd. From the appearance of Man to our own day. These different phases do not afford the same degree of probability.

1. *From the primitive Creation to the formation of the earth.*—The Physical Universe did not emerge from the hands of

[1] Kant was only 24 when he composed his *Theory of the Heavens.* He includes in a vast synthesis the formation of the whole Universe. On account of his inexperience, and want of knowledge of mechanics and physics, his book requires considerable revision on many points. M. Wolf has published an excellent translation in *Hypothèses cosmogoniques*: at the commencement of the work M. Wolf gives a close criticism and analysis of Kant's book.

[2] Laplace (1749-1827) occupies himself chiefly with the formation of the solar system by means of a primitive sun, very much heated, and dilated, and in a nebulous condition. "En vertu d'une chaleur excessive, l'atmosphère du soleil s'est primitivement étendue au delà des orbes de toutes les planètes, et elle s'est resserrée successivement jusqu'à ses limites actuelles. Dans l'état primitif où nous supposons le soleil, il ressemblait aux nébuleuses que le télescope nous montre composées d'un noyau plus ou moins brillant, entouré d'une nébulosité, qui, en se condensant à la surface du noyau, le transforme en étoile." (*Œuvres de Laplace*, t. vi. note vii. p. 471).

Laplace, in his hypothesis, assumes a sun containing a vast amount of heat; but after the discovery of the Thermodynamic laws, Faye was able to say that the nebulous sun was at first cold, and that heat was produced gradually, by the condensation of the mass, that is to say from the centripetal movement of the elements.

Laplace croyait que toutes les planètes et leurs satellites ont leur mouvement de révolution d'occident en orient: c'est ce qui lui permit d'adopter une loi uniforme pour la formation de tous les anneaux planétaires. On a découvert, depuis, que les satellites d'Uranus tournent dans un plan perpen-

the Creator in the state in which we see it at present. In the beginning, all the atoms which composed it were scattered throughout space, and were the constituent parts of an immense nebula of a very attenuated density.[1]

At the first, according to M. Faye, the universe existed in a general chaos of a rarefied mass, composed of all the elements of terrestrial chemistry, more or less mixed and in confusion. These materials, mutually attracted to each other, were from the first animated by divers movements, which caused their separation into small patches or clouds. These kept up rapid transitional movements, and slower gyrations within their mass. These myriads of chaotic pieces produced, by progressive condensation, the different worlds of the universe.[2]

diculaire à celui de l'écliptique, que le satellite de Neptune tourne franchement dans le sens rétrograde, d'orient en occident. Cette différence de mouvement des satellites a conduit M. Faye à distinguer deux temps dans la formation des planètes : dans un premier temps, la force centrale est proportionnelle à la distance, et les astres qui se forment ont tous des mouvements en sens direct, d'occident en orient ; dans un second temps, la force centrale s'exerce en raison inverse du carré de la distance, et les satellites planétaires qui se forment alors (dans Uranus et Neptune) prendront un sens rétrograde. Voir comment M. Faye lui-même s'explique sur ce point, pp. 276-281.

"Dans notre hypothèse, dit Laplace, les comètes sont étrangères au système planétaire. En les considérant comme de petites nébuleuse errantes de systèmes en systèmes solaires, et formées par la condensation de la matière nébuleuse, répandue avec tant de profusion dans l'univers, on voit que, lorsqu'elles parviennent dans la partie de l'espace où l'attraction du soleil est prédominante, il les force à décrire des orbes elliptiques ou hyperboliques," quoted in Faye, p. 159. M. Faye also considers them as "des matériaux non engagés dans le tourbillon primitif . . . qui échappèrent à la condensation centrale . . . (qui), partis des limites du chaos primitif, ont continué à se mouvoir dans des courbes allongées," p. 275.

[1] M. Faye pense qu'il n'y avait "peut-être que 3 grammes ou moins encore" de matière par myriamètre cube (p. 268). Or le vide de Crookes "n'est pas tellement dépourvu de matière qu'il n'en contienne 1,293,000 kilogrammes par myriamètre cube" (p. 227). La nébuleuse primitive aurait donc été 400 millions de fois moins dense que l'air raréfié du tube de Crookes. (*Sur l'origine du monde.*)

[2] (*Sur l'origine du monde*, p. 260.)

Amongst all these nebulous particles which formed the stars, one has a very special interest for us, that is the solar nebula. Originally it was partly spherical and homogeneous, having a slow circular movement of a uniform nature. Previously cold, it gradually became warmer as the elements condensed to form the Sun and the Planets.

These in fact were the foundations of all the stars of the solar system. In the equatorial regions the moving mass is distributed in flat concentric rings (Fig. 1). At the same time the elements of the remaining portion of the nebula fell towards the centre, or by their centripetal movements formed a single star-like body. Whilst the sun was thus being produced in the centre, and, from the movements, generating heat, and becoming caloric and incandescent, the concentric rings were producing planetary nebulæ by the grouping of the matter round one or more centres of attraction (Figs. 2 and 3).[1]

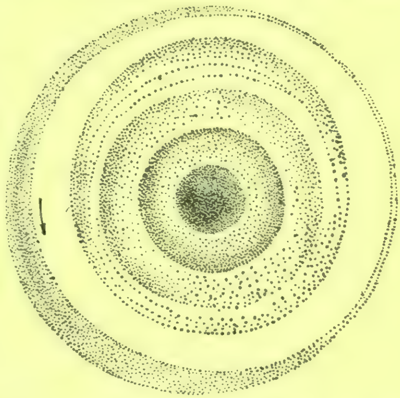

Fig 1.—Nebulosity of Laplace, seen from its pole. The concentric nucleus of the sun is in the centre. Around are the rings in which the planets are formed.

[1] Les idées de Laplace et de Faye, au sujet de la formation des anneaux, sont tout à fait différentes.—Pour Laplace, ce sont les anneaux des planètes les plus éloignées qui se forment d'abord ; Faye pense, au contraire, que ce sont les anneaux des planètes inférieures. D'après Laplace, Neptune est la première planète formée ; d'après Faye, c'est Mercure. Aux yeux de Laplace, le soleil existait au centre de la nébuleuse, au moment de la séparation des anneaux et de la formation des planètes ; suivant Faye, le soleil n'était pas encore formé quand les planètes inférieures ont pris naissance : en conséquence la condensation de la Terre, par example, a précédé celle du soleil. Faye explique par ce moyen comment la Genèse mentionne la création du soleil après la formation de la Terre (Fig. 6). See *L'Origine du monde*, pp. 278 and 287.

The planetary nebulæ, during condensation, have in their turn produced rings in whose midst satellites were formed (Fig 4); the nebulæ of Mercury and Venus did not cause satellites; but nebulæ appeared at a greater distance, such as the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

FIG. 2.—A ring becoming a globe by condensation. The external part *e* turns round the interior portion *i*, the rotatory movement of the planets producing this effect.

The nebulæ of the earth, after having lost the elements which formed the moon, slowly became condensed. As the elements fell towards the centre, their movements caused the production of heat. During a rather lengthy period the earth must have been incandescent like a star (Fig. 5). These resources of heat having become much lessened, it could not compensate itself for the heat it had lost by the radiation of light in space; and it developed the solid crust which surrounded it and began its geological phases.

2. *From the formation of the Earth to the appearance of Man.*—At the time when the earth lost its state of incandescence it must have shown three zones:

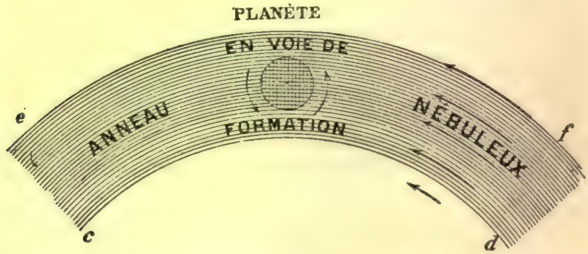

FIG. 3.—A planet in the course of formation in the midst of nebulous rings, according to M. Faye.

the *atmospheric zone*, which contained all the elements of the present atmosphere, all the vapours of our oceans, and

an immense volume of acid gases; a *stoney zone*, which when solidified formed the first crust of the earth; and the *metallic zone*, the greater part of which was liquid under the thin surface which covered it.

FIG. 4.—A planetary sphere, with ring, which will become a satellite.

When the face of the rocky zone was cooling, and becoming solid, the vapours condensed and formed oceans. After a space of time, of which it is impossible to measure the length, conditions suitable for life were fulfilled, and living beings appeared.

The first appearance of life marks the beginning of the geological eras known to all—viz., the Primary, Secondary,

FIG. 5.—The appearance which the Earth must have assumed when it became condensed and passed into a stellar condition.

Tertiary, and Quaternary. The climate and seasons became differentiated, little by little. The atmosphere, at first charged with vapours, gradually cleared, and allowed the

direct rays of the sun to penetrate to the surface of the globe. The living creatures perfected themselves as they multiplied. The vegetable kingdom, being dependent on the condition of the soil, followed a very slow order of progression. At first only cryptogams appeared, since those

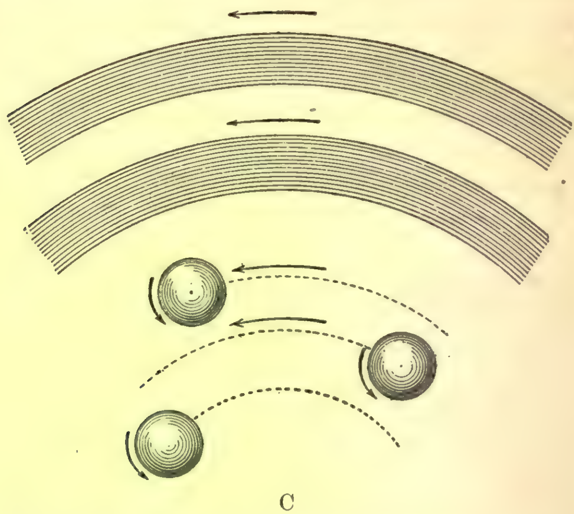

FIG. 6.—According to M. Faye, the inferior planets were formed before the superior planets.

of the lowest order came first (Fig. 7), the gymnosperms followed the ferns; the continents of the Secondary era were covered with monocotyledons; the dicotyledons, amongst which may be noticed the grasses, only attained their fullest perfection during the Tertiary era.

At the same time the continents assumed shape. The very marked emergence of the northern regions sent the oceans towards the south. After numerous alterations of the earth's surface, the geographical lines seemed definitely fixed.[1]

[1] See *Le Traite de Geologie* of M. de Lapparent, Paris, Masson.

3. *From the appearance of Man to the present time.*—In all probability, it was at the commencement of the Quaternary era that Man was created. The biological conditions of his environment were apparently the same as at present. What length of time has elapsed since man's appearance? As will be seen further on it is not possible to assign any certain date. At the most all that can be said is that his

FIG. 7.—A landscape of the carboniferous period; a damp soil not long emerged fern-like trees are growing, whose accumulated remains furnish fuel.

antiquity is very much less than that given him by the fables in the east, and the numbers mentioned by certain anthropologists.

This slight sketch of the history of the universe raises many questions.

This is the first. What degree of probability do these several parts possess?

The first phase, called the *astronomical*, is simply a scientific hypothesis, for its constituent parts cannot be the

object either of observation or experiment. But it is a highly probable hypothesis, in favour of which the most weighty reasons exist. It redounds more to God's glory to have created the worlds, by giving them, at the first, an impulse which contained the latent power of all evolution in the future, than to have formed them one by one in the shape in which they present themselves to us. The worlds do not appear to us to be in a stationary condition, but in a state of evolution which directs them to a goal; the stars are condensed and lose their heat; the planets, which were

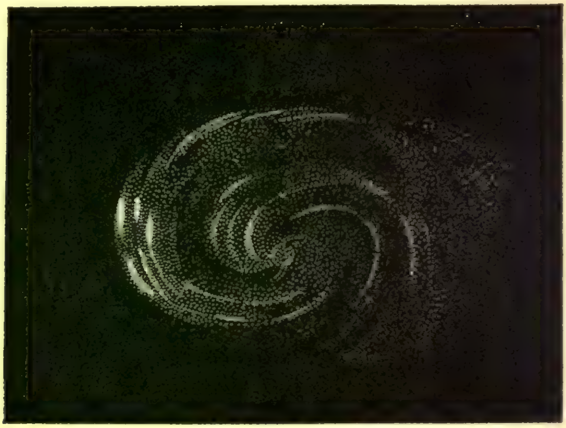

FIG. 8.—A spiral nebula.

like brilliant stars are constantly cooling, etc. . . . . The heavens show us astral bodies in all the stages, which the magnificent evolutions of the physical world would involve (Fig. 8); nebulæ—stars in all degrees of incandescence—planets with solid crusts, and satellites which had completely cooled. . . . . With regard to the solar system to which we belong, and which serves as a representative to us of those stellar worlds which are inaccessible to our investigations, its evolutions rest on the following reasons: all the planets turn obviously in the same plane, as also the detached

masses from the solar equator: they all present the same movement of revolution from west to east (Fig. 9): they all possess the same chemical composition, as the fragments which became separated from the first primitive mass.

It would not therefore be expedient to reject so reasonable an hypothesis. Moreover, in spite of some variations of detail, it is now generally received by the learned. It is

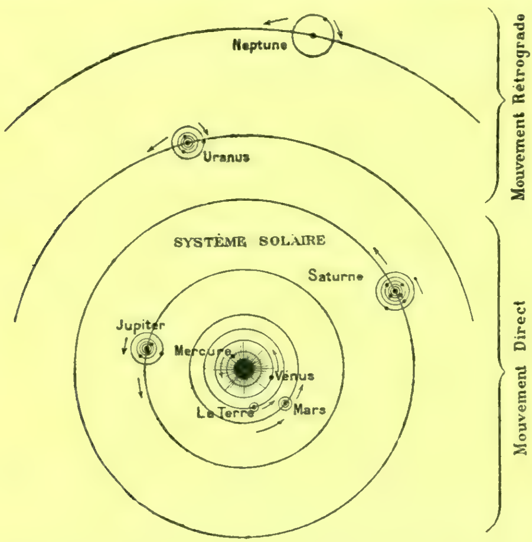

FIG. 9.—The distribution of the planetary orbits around the sun. The orbits, apparently circular, approach the plane of the ecliptic. The planets make all their revolutions from west to east; also the satellites, with the exception of Uranus and Neptune.

an accepted fact that the physical universe was formed by the slow action of natural laws on the primitive matter, apportioned out in chaotic nebulæ.

The second phase which is termed *geological*, no longer belongs to the domain of hypothesis; it has entered that of history. Geologists have, in fact, read the past of the earth

in the strata of its surface, as in so many pages, in which the ancient phenomena were faithfully registered; these pages can be deciphered by the aid of those phenomena of which we are now witnesses. If hypothetical solutions are still scattered amongst the geological history of the earth, its broad outlines are henceforth fixed and certain.

The third phase, which may be called the *human*, presents many obscure points; of one however there seems no doubt, and that is that Man goes back to between ten and twelve thousand years, that is beyond what has generally been admitted by us up to the present.

Can the number of the centuries which have elapsed since the hour of the creation be exactly calculated? No: since the calculation would lack solid data; the starting point must be hypothetical theories.[1]

This is however certain, that millions of years, perhaps of centuries, separate us from the movement given to the first nebula. The geological phase has been very long; according to Dana it must have lasted fifty millions of years.[2] The astronomical phase cannot be made the object of any calculation.

[1] Thus M. Faye, in speaking of the formation of the sun, says that it must have required fifteen millions of years in which to become condensed, that is, from its nebulous condition to the present time. But that is stated on the supposition that the sun has given out rays which always consisted of the same amount of heat. Now these premises cannot be allowed; the solar nebula was cold at first, too closely resembling the temperature of its environment to lose much heat. Thus a much higher number than fifteen millions of years must be assigned for the duration of the condensation of the sun. See *Origine du monde*, pp. 224-228. Lord Kelvin (W. Thomson), in his conferences on the solar heat also starts from these hypothetical or contestable data. (*Conférences scientifiques*, pp. 236-237, Paris, Gautier-Villars.)

[2] This is an example of the procedure followed by geologists to estimate the duration of time. At Paris, under the alluvium of the Seine, the chalk is 540 metres (about 1750 feet) deep (Fig. 10). This calcareous mass is composed of the remains of microscopic Foraminifera, resembling those which live on the surface of the tropical seas. Now, in these warm oceans, deposits of this nature "take place very slowly, and it is generally by millimetres =

Thus this theory of the natural formation of the universe does not invalidate the proof of the existence of God drawn from the order of the world. To place the Divine Action at the commencement of things does not make that action less necessary. It is necessary for the creation of matter; it is necessary for the origin of the first movement; it is

FIG. 10.—Organic constituents of the chalk, seen under a powerful microscope. The globigerinæ appear to be grouped in colonies.

even necessary to explain how the first impulse holds the same order which is afterwards realised and carried out by evolution. If God did not arrange the astral bodies by the direct action of His Almighty Power, He disposed them by a plan conceived of from the beginning; and the author of

$\frac{1}{1000}$ m., that the depth is reckoned, which has been formed during many centuries." (De Lapparent, *Abrégé de Géologie*, 3rd edition, p. 57.)

If we suppose that the calcareous mass increased at the rate of ten millimetres in one century, then the total deposit of 540 metres must have required 5400 years. And this chalky layer is merely a very small portion in proportion to the secondary formation.

a work is so much more glorious when his intervention acts from a distance.

§ 2. *The Biblical Cosmogony.*

Of all the cosmogonies which we have inherited from antiquity, the one most to be revered, on account of the inspiration which guided the sacred writer, the richest, from the intrinsic beauty of its recital, the purest, from the monotheistic doctrine which it explicitly teaches, is the cosmogony placed at the commencement of the Book of Genesis. It is contained in the first chapter. We give a translation from the Hebrew text.[1]

1. In the beginning Elohim created the heaven and the earth.

2. And the earth was without form and void. There was darkness upon the face of the deep. And the Spirit of Elohim moved upon the face of the waters.

I

3. Elohim said: "Let there be light," and there was light.

4. Elohim saw the light that it was good.

Elohim divided the light from the darkness.

5. And Elohim called the light day, and the darkness he called night.

There was evening, and there was morning; the first day.

II

6. Elohim said: "Let there be a firmament, in the midst of the waters, and let it divide the waters from the waters."

(And it was so.)[2]

[1] This translation has been supplied to me by my colleague and friend, M. Levesque, Professor of the Scriptures and Hebrew, at the Seminary of St Sulpice.

[2] "Et il en fut ainsi." In the Hebrew and the Vulgate, this sentence is at the end of the 7th verse; but according to the parallelism of the following days, and according to the Septuagint and Italic it should be here.

7. And Elohim made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament.

8. And Elohim named the firmament Heaven.

(Elohim saw the firmament that it was good.)[1]

There was evening, and there was morning; the second day.

III

9. Elohim said: "Let the waters under the heaven be gathered together unto one place[2] and let the dry land appear."

And it was so.

(And the waters which were under the heaven were gathered together in one mass, and the dry land appeared.)[3]

10. Elohim called the dry land earth, and the gathering together of the waters he called seas.

And Elohim saw that it was good.

11. Elohim said: "Let the earth put forth grass, herb yielding seed after its kind,[4] and fruit trees[5] bearing fruit after their kind, having in itself seed, on the earth."

And it was so.

12. And the earth brought forth grass, herb bearing seed after its kind, and trees yielding fruit, having in itself seed after its kind.

[1] The Hebrew has not this phrase; "And it was so" takes its place at the end of the 7th verse. According to the parallelism and the Septuagint and the Italic it should be placed here.

[2] Instead of the word *mâgôm*, place, the Septuagint gives *migvêh*, "gathering together," as in the next verse. According to this rendering it must be translated: Let the waters under the heaven be gathered together in one gathering, that is in one mass.

[3] According to the Septuagint and the parallelism of the preceding strophes.

[4] "After its kind" is added in accordance with the Septuagint and the 12th verse. The conjunction *vav* "and" is not in the Hebrew. According to the Versions, three Hebrew manuscripts, and the following verse, it should be used.

[5] The Hebrew and the Septuagint have *fruit trees*, which appears superabundant: as the words "bearing fruit" follow, it is not found in the parallel verse 12.

And Elohim saw that it was good.

13. There was evening, and there was morning; the third day.

IV

14. Elohim said: "Let there be lights in the firmament of the heaven, to distinguish the day from the night: that they may be for signs, and for seasons, and for days and years."

15. "And let them be for lights in the firmament of the heaven, to give light upon the earth."

And it was so.

16. And Elohim made the two great lights: the greater light to rule the day, and the lesser light to rule the night, and the stars also.

17. And Elohim set them in the firmament of the heaven to give light upon the earth, and to rule over the day and over the night.

18. And to divide the light from the darkness.

And Elohim saw that it was good.

19. There was evening, and there was morning; the fourth day.

V

20. Elohim said: "Let the waters bring forth abundantly the living creatures, and let fowls fly above the earth, on the face of the firmament of heaven."

(And it was so.)[1]

21. Elohim created the great sea-monsters, and every living creature that moveth, which the waters brought forth abundantly after their kinds, and every winged fowl after its kind.

And Elohim saw that it was good.

[1] This sentence is not found either in the Hebrew, or in the Vulgate. According to the parallelism of the other creative acts, and following the Septuagint and the Versions of Symmachus, Theodotion, and the Italic, it should be used.

22. And Elohim blessed them, saying: "Be fruitful, and multiply, and fill the waters in the seas, and let fowl multiply in the earth."

23. There was evening, and there was morning; the fifth day.

VI

24. Elohim said: "Let the earth bring forth the living creature after its kind; cattle, creeping things and beasts of the earth after its kind." [1]

And it was so.

25. And Elohim made the beasts of the earth after their kind, and the cattle after their kind, and everything that creepeth upon the ground after its kind.

And Elohim saw that it was good.

26. Elohim said: "Let us make man in our image, after our likeness: and let him have dominion over the fish of the sea, and over the fowls of the air, and over the cattle; over all (beasts of [2]) the earth, and over every creeping thing that creepeth on the earth.

27. Elohim created man in his image,
In the image of Elohim he created him;
Male and female he created them.

28. And Elohim blessed them: And Elohim said unto them: "Be fruitful, and multiply, fill the earth and subdue it. Have dominion over the fish of the sea, over the fowls of the air, and over every [3] creeping thing that creepeth upon the earth."

[1] The division is simple and popular: *Behêmâh* refers to domestic animals, large and small cattle; *rémés*, creeping things, not only those which literally creep, but all the small animals whose paws are hardly lifted from the ground; *hayat hâ'ârés*, beasts of the earth, all savage animals, not domesticated.

[2] A word is missing here: compare verse 24 and the Syriac Version.

[3] According to the Septuagint, and the 26th verse, it should be: "And over all (cattle, and all the beasts of the earth, and over all creeping things) which creep on the earth." But the *hâyâh*, "beast of the earth," such as is intended in this chapter, does not creep.

29. And Elohim said: "Behold, I give you every herb yielding seed, which is upon the face of all the earth, and every tree, in the which is the fruit of a tree yielding seed; this shall be for your nourishment.

30. And to every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth, wherein there is breath of life (I have given) every green herb for nourishment."

And it was so.

31. And Elohim saw every thing that he had made, and it was very good.

There was evening, and there was morning; the sixth day.

VII

1. And the heaven and the earth were finished, and all the host of them (and all the ordering of them).

2. On the sixth[1] day Elohim finished the work which he had made.

And on the seventh day, he rested from all his work which he had made.

3. And Elohim blessed the seventh day, and hallowed it; because that in it he rested from all his work which he had created.

4. These are the generations of the heaven and of the earth.

§ 3. *Concerning Cosmogony.*

With regard to the formation of the Universe, two documents have been set forth—the scientific and the Biblical. The scientific document is composed partly of certain knowledge, and partly of hypotheses which are generally accepted. The Biblical document comes to us weighted with its sacred character of inspiration. According to the scientific document God created the world by

[1] *The sixth*, according to the Septuagint, Samaritan, and Syriac; the Hebrew rendering which has *seventh*, is a fault of the copyist.

causing the natural forces to act, during an incalculable number of centuries. According to the Biblical document, it would appear that God created the world in six days, the several portions of which He ordered by the direct intervention of His Almighty Power.

Between these two accounts there is an apparent contradiction. How can it be shown that it is only apparent and not real?

It is well to notice that the question exists only for the believer. By those who do not believe in the inspiration of the Bible, the book of Genesis would be classed, with no special characteristics assigned to it, amongst the ancient writings, which are collected and restored with great care, but into the veracity of which no enquiries are made. For the believer, whether Protestant or Catholic, there is supreme interest in knowing how the words of God when compared with science can be proved free from all imputation of error.

For this reason only the opinions of those who consider the Bible a divine book will be recorded.

All interpreters agree on a certain number of principles, which we will here state briefly.

1. *There can be no real contradiction between the Bible and Revelation.*—In each case it is God who speaks to us, whether by the book of Nature or by the inspired Book. God cannot contradict Himself in His manifestations. If an apparent contradiction appears between the two languages, it must be caused by a wrong interpretation of the one or of the other.

2. *It is better to give the preference to a scientific certainty than to a doubtful exegesis.*—This refers to matters connected with science, on which it is not the object of the Bible to enlighten us. St Thomas Aquinas gives us the reason: "*ne scriptura ab infidelibus derideatur.*"[1] Suarez proclaims

[1] St Thomas Aq. S. Th. i. p. q. 68. a. 1, O.

this general principle: "*Sententiæ magis philosophicæ et rationi magis inhærendum est, quando scriptura non cogit.*" [1]

3. *The Bible and Science do not pursue the same end, nor employ the same means.*—The sacred writings are intended directly only for instruction in religious truths; but science studies the natural phenomena for their own sakes, in order to ascertain their laws and to discover their causes. The sacred writer speaks only of things concerning the universe according to appearances, and in conformity with the language used in his time: the man of science, on the contrary, seeks exactness, and the precision of scientific wording, he wishes to discover the truth hidden under the outward appearances, and his desire is to dissipate errors which come from a too hasty interpretation formed on the testimony of the senses.

It follows therefore that the Bible is a religious and not a scientific document; it cannot be invoked as an authority on matters connected with the natural sciences; it reflects the ideas which were current in the ages when the sacred writers lived. For the *history* of the sciences it is of great value.[2]

[1] Suarez, *De opere sex dierum*, l. ii. c. 7. *Cf.* Raingeard, *Notions de Géologie*, 2nd edition, p. 228.

[2] It will suffice to quote a passage from the Theology of P. Hurter, S. J.: *Compendium*, tract vi. pars ii. sect. 1, n. 193, borrowing it from M. Vigouroux, who, with reason, attaches a great importance to it. (*Mélanges bibliques*, 2nd edition. Paris, 1889, p. 17.) "Advertendum est, 1° Moysis scopum non fuisse tradere prælectiones doctas de astronomia, geologia, zoologia seu generatim de disciplinis naturalibus, sed institutionem tradere voluisse religiosam *vulgi captui accomodatam*; . . . 2° de hisce loquitur non more physicorum et doctorum, sed *concipiendi loquendique morem sequitur populi*. . . . 4° Inde sequitur longe pauciora esse themata seu argumenta communia cosmogoniæ mosaicæ et disciplinis naturalibus, ac plures contendere solent. Aliud tractat Moyses, circa aliud occupantur disciplinæ naturales; ille disserit de rerum *initiis*, de quibus scientia naturalis suis observationibus innixa nihil certi statuere potest; hæc observat phœnomena, inquirit in leges, secundum quas ordo præsens regitur, de quibus non est sollicitus Moyses; quare ipse, ut nonnemo acute loquitur, *præfationem* veluti scripsit ad disciplinas naturales, exponens rerum exordia; quæ hæc insecuta sunt, relinquit indaganda physicis peritis, secundum illud Ecclesiastis. *Mundum tradidit disputationi eorum.*" (Eccle. iii. 11.)

4. *The first chapter of Genesis contains certain definite religious teaching.*—"In short—it lays the foundations of all theology, it destroys all the errors of the ancient world —it establishes all the fundamental dogmata of religion:— the unity of God—the creation *ex nihilo*—Providence— the unity of the human race—the dependence of man on his Creator—the condemnation of Polytheism, Naturalism and Materialism."[1] If all the teaching in the first chapter of Genesis could be gathered into these points alone, it would still be of vast importance.

5. In interpreting the sacred text we must bear in mind not only the actual meaning of the words, but also the manner in which it was written, the people to whom it was addressed, the circumstances of time and place amongst which it was composed, and the object of the author; this is a primary rule in all textual criticism.

Even if all admit the justice of these principles, there is a great difference of opinion in their application. All believers agree as to the religious import of the account of the creation—from the Fathers of the Church to the commentators of our day: with regard to the scientific interpretation, apparently all systems of explanation have been brought forward.

Not one which acknowledges the inspiration of the text and upholds the value of its dogmatic teaching has been condemned by the Church. The Church leaves us great freedom of choice amongst the numerous opinions which solicit our assent; the Church has made no system her own, and has imposed none on her children. The Fathers are divided in their opinions, and adopt two explanations, one symbolic, the other literal; the Church approves of and blesses those who reject the one or the other, without either system being recognised officially. To-day, amongst those minds who submit themselves freely to her guidance,

[1] Vigouroux, *Mélanges bibliques*, 2nd edit., Paris 1898, p. 11. *Cf.* Castelein, S. J., *La première page de Moïse*, 1st conference, Louvain, 1884.

there may be found literalists, concordists, idealists and revelationists, etc., and the Church without intervening, follows their discussions.

From this fact come many consequences:

1. No one can claim that his opinion has the authority of the Church more than that of another.[1]

2. In the conflict between the divers opinions freely held in the Church, a writer would place himself beyond the bounds of true moderation, if he tried to impose his own system on others, as the only one compatible with faith.[2]

3. In a question so much discussed, it is more pertinent to make an historical statement of the work of the exegetist, than to propound a thesis as decisive, which is only tentative.

Therefore the best method that can be employed to throw light on the difficult questions, is to state, and

[1] "Le théologien a le droit de choisir le sentiment qui lui plaît davantage, en matière dogmatique, quand la tradition ancienne est divisée et vacillante, à moins que l'Église n'ait tranché, depuis, le différend; or, l'autorité infaillible ne s'est jamais prononcée, non seulement sur l'interprétation scientifique de la cosmogonie biblique, mais pas même sur la question de la création simultanée. C'est donc un fait avéré et incontestable que le catholique peut expliquer la cosmogonie mosaïque, en lui donnant le sens qui lui paraît le plus conforme aux données de la véritable science, à la seule condition d'observer les règles de l'herméneutique et de l'interprétation des Livres Saints." Vigouroux, *Mélanges bibliques*, p. 113.

[2] Par exemple, on est surpris de voir le P. Hummelauer, dans sa commentaire sur la Genèse, affirmer son système du *Révélationisme*: "non ut meram hypothesim, sed tanquam explicationem unice veram." "*Unica est*, dit-il, *ergo vera.* Nam aliquod tandem verum conciliandæ revelationis et scientiæ systema existat necesse est: ergo cum reliqua praæter hoc unum systemata demonstrata habeamus esse erronea, cum aliud præter recensita systemata proferatur nullum, hoc unum erit necessario admittendum." *In Genesim*, p. 72. No doubt there must be a way of reconciling science and Revelation. But is the author certain that he has found the best? The systems he rejects have champions as worthy as himself, and reasons which do not yield to his. Further, since he has not exhausted the list of possible systems, is he sure that a better one may not yet be found? That Revelationism has his preference is certain, be it so: but to wish to impose it on others . . .

examine critically, the principle hypotheses which have succeeded each other in turn amongst believers.

§ 4. *Cosmogony as taught by the Fathers and Theologians.*

In all that concerns faith and the interpretation of the sacred writings, the faithful Catholic begins by questioning the Church and Tradition. He accepts the teaching of the Church, he admits what has been handed down in the opinions common to the Fathers and Doctors. The Protestant also, though yielding to the guidance of his own judgment, is led by the needs of a spirit of enquiry to question and follow the ideas of antiquity in matters of faith.

In the account of the Creation given in the book of Genesis, we find two parts, the one which may be called dogmatic, and about which fixed ideas are retained, according to the teaching of the Church, and the unanimous conclusions arrived at by the Fathers and Doctors; and the other scientific, concerning which the Church has given no definite decision; and the Fathers and Doctors of all times have been divided, and which therefore one is at liberty to discuss freely.

The part which is called dogmatic, that is settled by the Church and Tradition, comprises several points; the account of the Creation is given by an author truly inspired in the theological sense of the word: the world was created by God: God is One and Personal: the works of God are good, etc. . . . These are not the points under discussion.

The scientific part, namely, that which is open to research by human understanding—since no authority has decided the meaning—is also composed of many points; and suggests these questions—has the account of the Creation an historical character? if its historical character

be admitted, which is the best method of reconciling the cosmogony of the Fathers with the Mosaic record?

The first question, that is as to the historical character, has divided the early Fathers, and still does the same with theologians and exegetists. The second has received very different answers, at different periods.

To show the justice of these remarks, we should trace the history of the interpretations of the account in Genesis, but refrain for the following reasons :—

1. This history has been written by M. Vigouroux in a pamphlet entitled "*The Mosaic Cosmogony according to the Fathers of the Church.*" [1] There is no need to repeat what has already been so excellently done. In looking over these interesting pages we see that the Fathers "are divided into two opposing camps, on an important point, viz. that of the duration of the Creation, the one side saying that it was accomplished instantaneously; the other that the acts were performed in succession." [2] Now it is evident that the partisans of the instantaneous Creation cannot look upon the account of the six days as an historical fact.

2. The writings of the Fathers do not throw much light on the subject now under discussion. In fact, from their divergences we chiefly learn the liberty accorded to interpreters. Moreover, if we remove the dogmatic points, which are not under discussion, the Fathers only apply to the subject the rudimentary, and sometimes erroneous, science of their time. Following this example we will apply in like manner the science of our time to the account; naturally it is not in their works that we must search for the means of doing this.

3. If the Fathers should guide us with regard to the scientific portions which occupy us, we should see those theologians and exegetists, whose respect for Tradition and Authority is beyond suspicion, following very exactly in

[1] Vigouroux, *Mélanges bibliques*, Paris, Berche, 1899, 2nd edition.

[2] *Mélanges bibliques*, p. 112. The whole argument is remarkable.

their steps. Now the many systems promulgated by the commentators show that great liberty of opinion is allowed us.[1]

Commentators are very unanimous in their replies to the attacks of rationalists on dogmatic points; but each one exercises a liberty of judgment on questions of scientific import, whilst holding himself immovable concerning principles of faith.

The opinions will now be stated which have been freely circulated during the course of the present century. And as there is nothing new under the sun, it will be seen that each of these opinions has connecting links with those of the ancient Fathers.

§ 5. *The literal interpretation, or Creation in six days of twenty-four hours.*

Literalism was no doubt the first system of interpretation used with regard to the account in Genesis, since each word is taken in its first plain sense. It was employed by many of the Fathers, and in our own century has found many partisans. Perhaps there are some persons who, from an exaggerated idea of its indicating a greater respect for God's word, hold it still.

This system acts on the principle that the sacred writings must be interpreted according to the obvious sense, when the meaning is clear, and there is no peremptory reason against it. This principle has always formed the chief support of literalism, and it is still appealed to by the new literalism used by modern criticism.

Now the obvious sense of the first chapter of Genesis seems to show—

1. That the account of the Creation is historical, since it presents the character and stamp of history.

[1] "The question concerning the nature of the six days cannot be decided on the authority of the Church nor the patristic writings." Brucker, *Questions actuelles d'Écriture sainte*, p. 163, Paris, Retaux, 1895. Now it is exactly the question of the nature of the six days which is occupying us.

2. That the Creation was accomplished in six consecutive days, since it is considered that in the mind of the author the word "day" could have no other meaning here than a space of twenty-four hours.

3. That no scientific difficulty can weigh against this sense, since God's power could execute in six days all the works in question.

In this manner, therefore, should the Sacred Text be read. In the beginning God called forth from nothing the matter of which the heaven and earth were composed. All the elements were mixed in one vast chaos, when God willed to place them in the order which they now occupy. In the execution of this great work He only employed six days of twenty-four hours, not because He required time to bring this work to perfection, but because in working for six days He wished to give man a model that He might follow in his work and repose. On the first day he created the light, and separated the day from the night; on the following day He divided the waters which were above—or clouds—from the waters beneath; in the third space of twenty-four hours He gathered the waters of the earth into oceans and covered the emerged continents with verdure.

At the beginning of the nineteenth century the progress of astronomy and geology shook the foundations of this system; it did not seem evident how the Creation in six days could be reconciled with the positive facts and well founded theories of science.

Literalism, however, was not rejected by all the interpreters; several systems were proposed in the effort to reconcile it with facts. We will enumerate them briefly.

1. *The hypothesis of a miracle.*—This hypothesis goes to the root of the matter; it takes Genesis "au pied de la lettre," and invokes the Divine power for all difficulties. For instance, the sun and the stars were made instantaneously, as we see them now; the crust of the earth was formed by the Finger of God with all the stratographical

and palæontological details, such as geologists have described (Figs. 11 to 18). God made all by single striking manifestations of His power without recourse to the slow pro-

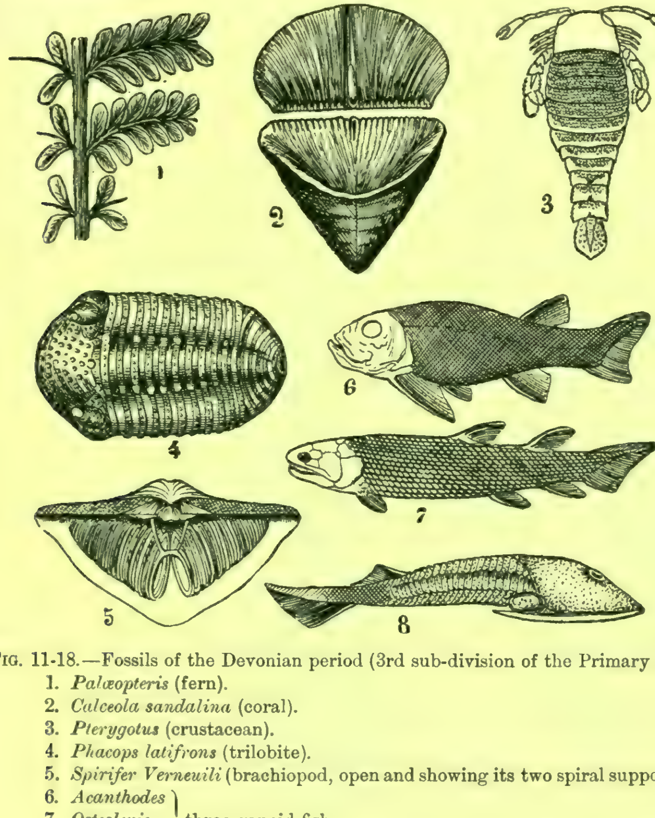

FIG. 11-18.—Fossils of the Devonian period (3rd sub-division of the Primary era).
1. *Palæopteris* (fern).
2. *Calceola sandalina* (coral).
3. *Pterygotus* (crustacean).
4. *Phacops latifrons* (trilobite).
5. *Spirifer Verneuili* (brachiopod, open and showing its two spiral supports).
6. *Acanthodes*
7. *Osteolepis* } three ganoid fish.
8. *Cephalaspis*

gressive action of natural forces; these forces did not begin their regular work until after the creation.

During the last fifty years this hypothesis has been contested by the exegetists; some persons who glory in the fact of not reading certain books, perhaps think and say

that we have not moved beyond it now. The exegetist believes in God's power, but he has not less faith in His wisdom also. Now, taking cognizance of the important data of science, he would consider it as an insult to the Divine wisdom to say that all had been done by instantaneous acts, when on the contrary it appears that all was accomplished by the well-arranged agency of secondary causes.[1]

2. *The post-hexameric system.*—The theory is thus named according to which the geological phenomena, accomplished by natural forces, are thought to have taken place after the six days of creation, and consequently after the appearance of man. As soon as the rudiments of the world were called out of nothing, the elements were regulated and ordered in the six days; and the successive revolutions and phenomena, whose traces are found by science in the crust of the earth, were produced during the space of six or eight thousaud years.

P. Hummelauer attributes this system to many French and German authors.[2] The greater number consider that the succession of beds found in the earth's surface were deposited by the universal deluge; they might therefore be called *Diluvianists.*

This hypothesis, however, has the misfortune of agreeing neither with the account of the Deluge, nor with the geological records. The Deluge of Noah only lasted eleven months; now an inundation of eleven months would only leave unimportant and transitory traces, soon effaced by flowing waters. It is impossible that the facts of geology could have been accomplished in the short space of time succeeding the appearance of man; moreover the climatic conditions under which the first layers were formed, would be

[1] We will not further develop this point. To see how the exegetists agree with the learned, it will be well to refer to Vigouroux, *Manuel biblique,* 10th edition, t. i. p. 462, and all modern commentators.

[2] He names P. Laurent *Études géologiques,* Paris, 1863; Sorignet, *La Cosmogonie de la Bible,* Paris, 1854, amongst the French authors.

incompatible with the life of man and of the higher animals; and yet according to this theory, man and the higher animals were created previously to the Primary epoch.

3. *The Ante-hexameric system.*—Much more scientific, at least in appearance, is the hypothesis which places all the phases of geology and astronomy between the first creative act and the work of the six days. In the beginning God created all the elements of the universe. Then during the millions of centuries which the Bible does not mention, the earth underwent its natural evolutions; the stars were formed, and the crust was fashioned by secondary causes. At the end of the Tertiary era, a general catastrophe mixed the elements on the earth's surface; this is the chaos spoken of in the 2nd verse of Genesis. Then in six days of twenty-four hours, God restored His work which He crowned by the creation of man; this system is thus sometimes known by the term *Restitutionism.*

This interpretation, which was invented by Chalmers and Buckland, and afterwards adopted by Wiseman, Molloy, Desdouits, de Genoude, has some advantages.[1] It allows the necessary length of time for the geological formations, it preserves to the word *day* its natural meaning, and its historical aspect to the account, and it avoids setting up a dangerous comparison between the geological periods and the works of the creation.

But it has been abandoned, as it is confronted by insurmountable difficulties. Nowhere are traces found of the great catastrophe. Undoubtedly Cuvier had expressed the idea that during the geological periods, the surface of the earth had been renewed many times after general revolutions; but fact contradicted this; cataclysms were never sudden and

[1] Chalmers, *Review of Cuvier's Theory of the Earth*, Edinburgh, 1814; Buckland, *Geology and Mineralogy, considered with reference to natural theology*, London, 1838; Wiseman, *Twelve Lectures*, London, 1849; Molloy, *Géologie et Révélation*, traduction de l'abbé Hamard, Paris, 1877. See Migne, *Démonstrations évangéliques*, t. xv.

universal; never have living species been completely destroyed and renewed at one time; the Tertiary species, for instance, are very numerous in the succeeding age. The renovation of the earth in six days of twenty-four hours would have been a miracle, the motive for which we should fail to discover. Had the stars also been destroyed which appeared on the fourth day? As Scripture places no interval between the 1st and 2nd verses it is more natural to suppose that the condition of the elements was chaotic immediately after creation.[1]

§ 6. *Concordism, or the system of Day-periods.*

Literalism fails in the interpretation of the work of the six days, because it holds firmly to two points, the obvious sense of the text, and the historical character of the record. Concordism, or the system of day-periods seeks to arrive at a better result, by sacrificing a little of what appears to be the obvious meaning, but keeping intact the historical character.

By its adherence to the historical aspect, Concordism follows the opinions of the majority of the Doctors; but in its conception of day-periods it is quite modern. It grew in proportion to the changes brought about by the geological discoveries; in its manifold diversities, it seeks to find in the sacred text traces and indications of the phases through which the world has passed; it is on account of the parallelism drawn between the days in Genesis (which are considered as long periods) and the geological epochs, that it possesses the name of *Concordism*, or the system of *Day-periods.*[2]

[1] It is unnecessary to extend this refutation, since the system is classed with those which no longer exist.

[2] The chief representatives of this system are M. Vigouroux and P. Brucker; also Marcel de Serres, Fabre d'Envieu, Pianciani, de Rougemont, Reush, Meignan, Güttler, Hautcœur, Arduin, Dupaigne, Hellinger, Raingeard, Lavaud de Lestrade, Castelein, Jean d'Estienne, Faye, Pelt, etc. . . . See the titles of their works in the bibliography which follow this chapter.

1. *The Principles of Concordism.*—The principle of the concordist is that the account of the Creation is a *real history.* M. Vigouroux brings forward in proof of this its moderate tone and the clearness and precision of its style (*Manuel biblique*, p. 451 of the 10th ed.). According to P. Brucker's opinion, if this chapter were not historical, " it would be difficult to find parts more strictly so in the Bible." P. Petau thinks there is a sufficient proof of " the succession of events in the six days," in the repetition of the words: " And there was evening and there was morning." (*Questions actuelles d'Écriture sainte*, p. 165.)

On the other hand, the concordist freely accepts all the scientific data: the probable hypothesis that the earth has passed through a long astronomical phase, before the geological eras; and the certain deductions which demand millions of years for the formation of the crust of the earth.

In his eyes, Genesis and geology narrate, in different styles, the same history of progressive evolution. Between two parallel accounts of the same subject it should not be difficult to find agreement; not only should they not contradict each other, they should agree, at least in their main lines. How can we find in the *days* of Genesis traces of the long geological periods?

2. The concordist solves this difficulty by interpreting the word *day*, not as a space of twenty-four hours, but in the sense of a period of time as long as is required by science. It is by reading *period*, wherever we find *day* in Genesis, that Concordism marks its chief characteristic. That the interpretation is new is of no consequence in his opinion. Geology requires it and the Bible permits it.

Geology requires it, certainly, if the account should be considered strictly historical; since it teaches us that the world was formed by secondary causes, during lengthened periods of time. Either the sacred writer does not give us the history of the earth, or the days of Genesis are periods of long duration.

The Bible permits it, since eminent Hebraists affirm that the Hebrew word *yôm* (translated by the word *day*) can also indicate a period of indefinite length—a long interval of time.[1] It is true that other Hebraists deny this, but in a discussion on the question, it cannot be considered conclusively settled on the side of the duration of twenty-four hours.

3. It remains therefore to find a real and intentional agreement between the days of the creation and the natural phenomena recognised by science. Evidently this agreement cannot exist in the minute details, and it can only be maintained with certain reservations, but it must exist.

The sacred author has only noticed the *chief characteristics* of the works of God in the creation. He has kept back all that did not tend to the furtherance of his purpose. Wishing to bring into high relief the power and wisdom of the Creator, he omitted all mention of subjects unknown to the people, such as molluscs, zoophytes, and marine plants.

He describes each work at *the moment of its greatest perfection*, or in other words, at the moment when it is the salient point of the creation. Thus plants existed before the third period, and many fish before the fifth; but the plants and fish are mentioned at the moment when they constitute the most prominent part of the creation. All that is in progress, or the modification of a work which has already been noticed, is passed over in silence.

The *chronological order* is that adopted in Genesis, not because God only achieved one work in each period, but with the meaning that each period was characterised by the special work described in the sacred text.

2. *The Concordance.*—Many attempts at reconciliation have been made, but some have been abandoned because they did not accord with the natural and obvious meaning

[1] Vigouroux, *Manuel biblique*, t. i. p. 455, 10th ed.

of the words. We shall give in a tabular form the Concordance which appears the most reasonable.[1]

The Account in Genesis.	The Formation of the World according to Science.
The Prelude. The Creation of the Heaven and the earth. Gen. i. 1.	The Cosmic Period. The nebulous matter, created by God becomes separated into many worlds. The solar mass gives rise to the formation of the planets, afterwards of the sun. The earth, one of the planets, passes into a state of incandescence.
The earth is in a condition of chaos and darkness. Gen. i. 2.	The earth, at first a liquid mass in fusion, is gradually encrusted ; then covered with oceans of acid and burning water, in which no life can exist ; only a dim light penetrates the atmosphere, filled with thick vapours.
The first day. The Creation of *Light.* Gen. i. 3-5.	Primitive Time, preceding the appearance of life, in which interval the atmosphere becomes clearer and allows light to inaugurate the regular succession of day and night. The direct rays of the sun do not however reach the earth.
The second day. The separation of the waters above the *firmament* from those below. Gen. i. 6-8.	*The Primary Era* (1st Part) during which time the atmosphere becomes clearer by the condensation of the vapours. In this way is brought about a separation between the clouds and the waters on the earth ; the pure air spreads itself between the waters, and by its great depth appears to form a solid vault or firmament. Already living creatures multiply in the seas though no mention is made of them.
The third day. The separation of the seas and the *continents.* Gen. i. 9-10.	*The Primary Era* (2nd Part). Land begins to appear at this time. The north of Europe, of Asia, and of America have almost entirely emerged at the end of the Devonian period.
Production of *plants.* Gen. i. 11-13.	After the emergence of the continents the earth is covered with vegetation ; in fact, during the carboniferous period, the plants of the earth are so abundant that they form everywhere rich deposits of coal.

[1] It is very similar to the one given by M. Vigouroux in the *Manuel biblique,* t. i. p. 422 *et seq,* and to that in *Notions de Géologie* of M. Raingeard, p. 266. See also Faye, *Sur l'origine du monde.*

The fourth day. The astral bodies adorn day and night. Gen. i. 14-19.	*The end of the Primary, and the beginning of the Secondary Era.* The heavenly bodies become visible owing to the greater purity of the atmosphere. There is already day and night, but now first appear the sun by day, and the moon and the stars by night.
The fifth day. The creation of the marine monsters, and winged creatures. Gen. i. 20-23.	*The Secondary Era:* the Jurassic and Cretaceous periods. It is now that the large reptiles, viz., the Icthyosaurus, the Plesiosaurus, etc., reign in the seas, and on the banks; and that the first birds make their appearance.
The sixth day. Terrestrial animals. Large herbivorous quadrupeds; creeping animals, and wild beasts.	*The Tertiary Era.* The mammalia become developed on the continents; reptiles and birds multiply; towards the end of this era the large herbivorous quadrupeds are conquered by the wilder animals.
Man. Gen. i. 24-31.	*The Quaternary Era.* Man appeared during the Glacial period.
The seventh day. The *Sabbath* of God. Gen. ii. 1-3.	Since man's appearance the earth has remained comparatively stable; it retains its shape and its elevations; the animals and plants appear perceptibly the same.

Such is the Concordance which the system of day-periods establishes between the scriptural text and the science of cosmogony. According to the concordist, science, in confirming the account given in Genesis, brings forward a fresh proof of the inspiration which guided the author. "Without the miracle of Revelation, the miracle of this agreement could not be explained" (Castelein, *La première page de Moïse*, p. 528). "If this document (the Mosaic writing) be true . . ., it follows that it has a divine origin" (Dana, *Manual of Geology*, p. 767).

3. *Concordism criticised.*—Monsgr. Clifford, the Catholic Bishop of Clifton, however, wrote in 1883: "The theory of periods in no wise nullifies the special difficulties raised by the learned against the first chapter of Genesis."[1] This

[1] Clifford, *Dublin Review*, April 1883, p. 398. *Cf.* de Foville, *Revue des Questions scientifique*, April 1884.

opinion is certainly exaggerated, but it shows that Concordism, in spite of its real advantages, is confronted by very serious objections. It has never obtained the suffrages of all the apologists. Its partisans have attenuated and idealised it, in proportion as they felt the difficulties to which it gave rise. In spite of its well-equipped defenders, it appears more and more to fall into disfavour.

Among the objections which are brought forward against it, some have an exegetical character, whilst some are taken from the domain of science.

It is not well to lay too great stress on the novelty of this system, since it is easy to understand, that, in order to solve modern difficulties,recourse must be had to modern arguments.

What is of more importance is that it departs from the obvious meaning. In fact, even the most moderate of the concordists are compelled to translate the first chapter of the Bible into a résumé of modern cosmogony, as we have shown in the previous table. But this interpretation would have been impossible to the Hebrew people for whom the account was made: even to-day, the reading of this portion of Genesis, at the first sight suggests other explanations; a special education is required to recognise a chapter on geology in the sacred writing. All systems seem dnbious when they depart from the obvious meaning.

The rendering of the word "*yôm*" into long periods, instead of into days of twenty-four hours, seems to some interpreters of mark to be contrary to all rule. It will suffice to refer the reader to P. Hummelauer's commentary on the Bible.[1]

P. Castelein asserts, as has been quoted above, that Moses must have had a true scientific revelation, in order to write this chapter. But it is generally admitted amongst the

[1] P. Hummelauer explains in the following manner all the biblical examples which are generally quoted to show that the word "*day*" can be taken in the sense of "*periods.*" "In quorum locorum nullo *dies*, longam periodam significat, sed a significatione determinata et propria durationis 24 horarum ad significationem indeterminatam durationis universim spectatæ, viginti quatuor horis sive longioris sive brevioris, descendit." *In Genesim*, p. 61.

exegetists that the Scriptures only treat of scientific matters for purposes of religion, and in conformity with appearances and already received ideas. It would require very convincing reasons to believe that the Holy Spirit had in this case departed from His usual custom. It would be necessary, for instance, to have indubitable and exact scientific data. On the contrary, general terms are used, borrowed from the language of the people.

Since the system of the day-periods was invented for the exigencies of geology, it is only just to examine it by the light of science. Now even if the parallelism which has been indicated is not contrary to science, at least it is artificial and without foundation.[1]

Now the six divisions of the days in Genesis, have not their counterpart in the science of geology. In fact, the time which has elapsed since the creation to the present day cannot be divided into natural periods. It is with geology as with history; the phenomena which characterise one portion of history in a certain country have no meaning for another country; in the same way the divisions known to, and accepted by, geologists are entirely artificial, and the facts which fix their limits are only of value for certain countries. Thus the day-periods, which appear to be clearly marked divisions, have nothing definitely corresponding to them in geology.

Moreover, the manner in which Moses has grouped the works of God is an arbitrary one, as well as the epoch to which each is referred. God having fashioned the world by the slow process of secondary causes, all was done simultaneously—all the works were in progress at the same time; so that with the exception of the beasts of the earth, and man, all could have been named together, as belonging to the same epoch. At any special moment it might have been said; the atmosphere is clearing, and the difference

[1] For a detailed refutation of Concordism, see P. Hummelauer's *In Genesim*, pp. 60-65.

between day and night becomes more evident; an open space widens out between the clouds and the waters on the earth; the continents become more marked day by day; the air gains in transparency, and the stars become more and more visible; as the earth is cooling, the vegetable kingdom is being evolved and progresses with a majestic grand regularity; the animals which were numerous from the beginning of the primary era multiply, and become more and more perfect.

This being so, if the first chapter of Genesis had been differently drawn up, the Concordance would still exist.

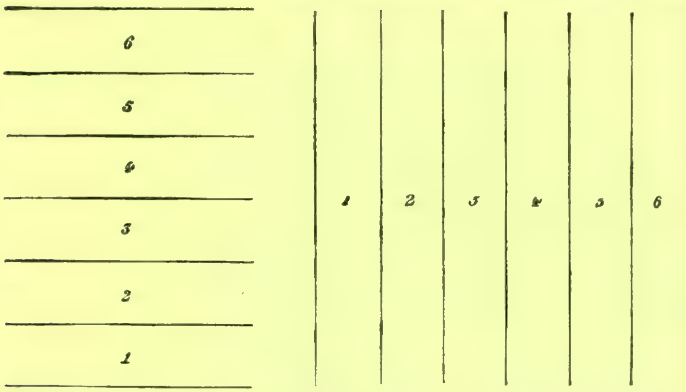

FIG. 19.—To the right the succession of the works of creation; to the left the parallel series of geological events. In whatever order the figures of the columns to the right are placed, they will always be found to face the column of the same number to the left.

The works of the five first divisions must of necessity agree with geology in whatever order they are placed, And as five objects are capable of 120 different arrangements, it proves that there would be 120 ways of placing the events in the chapter without destroying the parallelism. In this case as in others, "*qui prouve trop, ne prouve rien.*" Genesis shows a series of successive objects; geology presents them to us as a series of parallel objects. It is not well to compare what is successive with what is parallel (Fig. 19). Neither the commencement, nor the culmination

of a scientific fact corresponds exactly with the "*day*" in Genesis.

§ 7. *Idealism, or the system of Metaphorical Days.*

Idealism can be traced back to the Alexandrian school. Adopting the system of Philo, the Alexandrian Fathers, Clement, Origen, St Athanasius and St Cyril believe that all creation was produced at one time; that the division into six days does not indicate succession in time, but that the author wishes only to represent to us in pictures, suited to our intelligence, the gradual ascent of all the beings forming the universe. In the Latin Church St Augustine holds to this opinion, and lends it the weight of his great name; he thinks that God created all His works instantaneously, at least their origins, or "raisons séminales"; but that the author presents them to us in six pictures to make them more obvious to us. Impressed with the authority belonging to St Augustine's opinions, St Thomas Aquinas always hesitated between idealism and literalism; he does not give a final decision in his "Summa."[1]

Modern idealists may thus quote glorious authorities for their adaptation of the sacred text. We shall state the principles common to all idealism before enumerating the different forms of this system.

I. *General Principles of Idealism.*—Literalism fails because it insists on following too closely the literal meaning; Concordism, on the other hand, considers it too exclusively an historical recital. Idealism sacrifices alike its historical aspect properly so called, and its strict literal meaning.

1. Idealism recognises a certain amount of historical reality, since the sacred writing relates to real facts, the

[1] See the historical exposition either in Hummelauer's *In Genesim*, pp. 49-55; or in Vigouroux's *Mélanges bibliques*, I. *La Cosmogonie mosaïque d'après les Pères de l'Église.*

facts which constitute the formation of the universe, but strictly speaking, history is something more than this; it supposes that the author recounts facts exactly as they have happened; whilst following the chronological order, at least in the chief outlines of events. Now idealists say, the sacred author mentions the important facts of cosmogony, without giving the manner of their production, and without placing them in their natural order, seeing they are evidently classed according to a logical order independently of the real sequence of events. Thus the author does not furnish an account really historical.

These are some of the arguments alleged in favour of this conclusion.

The style of the recital is not historical, but poetical. Certainly it was not composed in verse, since there is neither metre nor parallelism; but verse is not essential to poetry. The dramatic tone, the background in which the scene is laid, the glorious idea of causing the sudden appearance of all things at the voice of God,—whereas in reality the Divine act produced the world slowly and under the influence of secondary or natural causes,—the division into six strophes ending with the same refrain, and preceded by the same words; a prologue (v. 1 and 2) and a conclusion (ii. v. 1 and 2) enclose it: such are the traits, sketched in slightly, which characterise the poetry; moreover, this first chapter of Genesis has always been cited as an example of a most sublime poem.

The piece seems detached from the rest of Genesis, both from the objects of which it treats, and the character of its style. There is nothing surprising in the fact of the inspired author having placed the idyll of the Creation as the frontispiece of the religious history of the Israelites.

The arrangement of the matter is made according to an ideal plan: the three first days are devoted to the separation of the elements, and the three last to their adornment; the same objects are placed in the same order in each part.

On the fourth day God adorns the day and the night which had already been divided; on the fifth day He plenishes the waters which are below, and the firmament and waters above, whose separation was effected on the second day; finally, on the sixth, He adorns the dry land, separated from the waters on the third day. It will be understood that such an arrangement does not readily lend itself to chronological development.

The author could not write a *real history* of the creation except as the result of a revelation. The Church teaches us that this work was written by inspiration, but it does not teach us that it was by revelation; all know the difference between inspiration and revelation. Doubtless a revelation might have been made to the author, but restricted to dogma, without extending to the domain of science; since it is not in accordance with the usual method of Holy Scripture to give us revelations of scientific matters.

In the present case a scientific revelation does not appear to have been made. In fact, there seems to be nothing to lead the learned to any discovery. It is only by a forced application of the text that an allusion can be found to the modern discoveries of science. The chapter can be perfectly understood without supposing that the author was supplied with scientific data.

What does the author of Genesis desire? Two things— First, to teach the Unity and the Almighty Power of God as Creator. Second, To establish the week and the Sabbatical rest. For these two objects he received a divine mission to write; thus those think who believe in inspiration.

In order to bring the grandeur and unity of God into great prominence, the author describes Him as bringing the whole universe out of nothing by His Word of Power, ordering and arranging all the elements of this world Himself; making all good, and preparing all with a view to Man whom He establishes King over all created things. What are the most important phenomena of nature? the most evident in the eyes of the people? the most sublime

in successive changes, and in the cause which produced them? The day and night; the oceans and clouds fertilising the ground; the birds which embellish the firmament, the creatures which multiply on the earth and in the seas; it is the God of Israel who has created them all; it is He who is the Ruler of the world, and the Supreme Lord to be adored.

And since man had to perform his duty to God by the work of six days, and the rest and sanctification of the seventh, the inspired author distributed the divine acts in six successive representations, which figure to us the six working days: followed by the rest of God, the pattern of the Sabbatical rest. The proof that this plan is figurative, and designed in view of the institution of the week, is that God on account of His omnipotence and immutability, does not require the six days in which to accomplish the creation of the world, nor does He in reality pass from labour to rest, as man does.

The better to impress these dogmatic truths, and these rules of action on the minds of the Hebrew people, Moses put them forward in the concrete form of a recital, endowing them with a poetic dress of regular strophes, and an elevated style, and emphasizing God's action of creating each creature by the power of His vivifying word. He sings of the Creation, but the separate acts of it are not placed in chronological order, he does not say whether God created the things directly or by secondary or natural causes. In the poetical fervour which animates him, he places each work in the space of a day, of which the words "evening and morning" express the natural limits.

The believer considers this mode of procedure to have been inspired by God.

Thus speaks the idealist. He considers his interpretation more simple than the preceding one; he thinks that his system relieves the sacred writing from being confronted with the results of science; he thinks that an Oriental race,

possessing an imagination more poetical than ours, would perfectly understand this mode of expression. He considers that he walks in step with the Fathers who believed in instantaneous creation. Instead of saying with St Augustine, that Genesis presents in six days what God performed in an instant, he allows that Genesis presents to us in six days what God performed according to geologists in millions of years by secondary causes. In each case what is considered the real order gives way, that an *ideal plan* may be presented.

2. Since the idealists reject the historical interpretation, they cannot insist on the strictly literal meaning. The word *day* is not used in its ordinary sense, but figuratively.

For instance they do not admit that the sacred writer intended to convey the impression that the stars were formed in a space of twenty-four hours, nor on the fourth day, or fourth period, nor after the division of the waters, and the appearance of plants; but only that the stars, like the rest of nature, were the work of the one true Almighty God. At what period they were formed, or became visible, whether they were created by one immediate act, in their present state, or by the effect of a progressive evolution, the Bible does not tell us, but leaves to science the task of research on these points.

Such an interpretation necessarily abandons the meaning which at first appears obvious. The reader will not expect to have the method applied to all the works mentioned.

II. *The different forms of Idealism.*— The system of the Alexandrian Fathers may be called *allegorical.* According to Origen, God created all at one time, in accordance with His words: *Creavit omnia simul.* (Eccl. xviii. 1). The six days are purely allegorical; Heaven signifies the angels; the deep, the infernal regions; the waters above and below are the good and bad angels; the sun and the moon are Christ and His Church.[1]

[1] Hummelauer, *In Genesim*, p. 49. *Cf.* Vigouroux, *Mélanges bibliques.*

St Augustine rejects the allegorical theory, substituting for it the *idealistic plan.* God made all from the beginning; some of the things created had their present nature, such as the elements, the stars, the angelic spirits; but others were only in the germ form, in view of their future development, such as plants and animals. The chapter in Genesis is considered a doctrinal treatise, in which the division of the works does not imply the distinction and succession in time, and in which the six days are used only as an artificial means of indicating six kinds of divine acts.[1]

Modern Idealism appeared about 1850. In France the Catholic writers leaned, by preference, towards Concordism; whilst the German and English authors inclined towards a more or less pronounced Idealism.

Michelis,[2] who seems to have been the first champion of his system, explains it in the following manner. "Of two authors, each one writing a history of Charlemagne from his own point of view, one might adopt a strictly chronological arrangement, in which perfectly disconnected events might follow each other, with no association. The other writer might treat the same subject with equal ability, following a series of striking facts chosen for special reasons; he could, for instance, consider Charlemagne in his connection with the State—as legislator, as Christian, as father of a family, etc.—and this method would not be wanting in historical accuracy." Thus Michelis puts forward the biblical recital in a parallelism of three days, as has been already mentioned.

Güttler,[3] with his concordist theory idealised, approaches more closely to the historical aspect. He admits a certain

[1] Castelein, *La première page de Moïse*, p. 60. For the references to St Augustine's works, see Hummelauer and Vigouroux.

[2] Professor of Theology to the Catholic faculty at Breslau. *Natur ünd Offenbarung*, 1855, Münster.

[3] Güttler, *Les Études naturelles et la Bible*, Herder, Fribourg in Brisgau, 1877. See the account of the work by M. de Foville, *Revue des Questions scientifiques*, t. vii.

chronological order, conforming to the obvious signification of Scripture ; but he has recourse to idealistic principles to explain why the sacred author swerves from exact chronology. The history is made subservient to a plan, which plan is determined by the logical relationship of events rather than by their succession ; the things are not recorded at the moment of their appearance, but when required by the exigencies of the author's plan.

Reush,[1] who was a concordist in the three first editions of his book, became an idealist in the fourth. God, he says, permits us to know that the world is His work ; when—in what order—by what process, God has produced His works, are not essential parts of religion, and are not told us in the Bible ; the days in Genesis are only used as a symbol of the week, which must end by the repose of the seventh day.

Schæfer [2] introduces us to a new system, that of *Revelationism*, which P. Hummelauer upholds with much vigour. We borrow from M. de Foville a résumé of Schæfer's book.

1. In the Hexameron, Moses is the arranger or inspired reporter of a tradition which is traced back with regard to its foundation and form to the Father of the Human Race.

2. The Hexameron was revealed to Adam, by means of *visions,* and thus resembles many of the revelations which were vouchsafed at a later period to the prophets.

3. The order which is assigned to the works of creation by the sacred text, is the same as the successive pictures which formed Adam's vision. This account is the faithful reproduction of the vision ; for each representation seen in the vision, there is a corresponding day in the Scripture.

4. This scheme of *revelation* is not considered identical, however, with the order of production of the things created,

[1] Reush, *Bible et Nature.* There is a French translation. The 4th edition is dated 1876.

[2] Dr Schæfer, Professor of Exegesis at the Academy at Munich, *La Bible et la Science*, 1881, Münster. M. de Foville has made a very detailed analysis of the work in the *Revue des Questions scientifiques,* t. xii. 1882-83.

it is an order of intellectual conception communicated by God to the seer. To show how uncertain the historical part is P. Hummelauer uses this comparison. "Just as Herodotus and Livy placed at the commencement of their histories, certain legends and popular myths, so the sacred author places at the beginning of his book a cosmogony borrowed not from myths but from a revelation. As with the historians who fail to discern what is historical from what is legendary, however carefully they may examine the myths, so the author of Genesis may not have distinguished, in the revealed cosmogony, what was historical, and what was added for religious instruction. . . ."[1]

Monsgr. Clifford,[2] Catholic Bishop of Clifton, put forth the *Hymn System*; for the résumé of which we shall quote his own words.

"(The first chapter of Genesis) is a sacred hymn, repeating the consecration of each day of the week to the memory of one or other of the acts of the one true God, Creator of heaven and earth; in opposition to the custom of the Egyptian priests of connecting these same days of the week with the sun, the moon, and the planets, as the names of the months are also sacred to the memory of the great deeds of their false gods. When it is said that certain acts were performed on certain days of the week, it has no other signification than that the days are consecrated to the memory of the work in question. With regard to the order in which the various parts of creation came into existence—and with regard to the period of time, whether long or short, which elapsed previous to the earth assuming its present appearance—these are questions which are no

[1] Having thus expressed himself, it is surprising that P. Hummelauer should summarily condemn Idealism in another passage as follows: "Auctores pauci, argumenta obstrusa, causa desperata." *In Genesim*, p. 67.

[2] Mgr. Clifford has published a series of articles in the *Dublin Review*, April 1881, October 1881, January and April 1883. M. de Foville has given an analysis of them in the *Revue des Questions scientifiques*, January 1882, and April 1883.

part of Moses' design, and which he was not concerned to explain. In no place does he make allusion to them; the result is that at whatever conclusion the learned arrive on these matters, they will find neither contradiction nor confirmation in the account of Moses." [1]

This dissertation has two parts—the first attracts few followers, because it seemed to have no foundation, and to be useless in explaining Genesis; the second, entirely idealistic, has, during the last fifteen years had an influence on a movement amongst Catholics, towards pronounced idealism.

III. The Idealism, which has been explained, meets with two sets of opposers—the Concordist and the Critic; the first considers that it sacrifices the historical aspect too much; the second reproaches it for departing from the natural and plain meaning of the text.

"We reject this system," says M. Vigouroux, "because we believe . . . that the first chapter of Genesis is historic. Nothing in the sacred text leads one to suppose that the language of Moses is to be taken in an ideal sense." [2]

P. Brucker also considers the account of the creation to be strictly historical, and that consequently, no idealistic hypothesis can be based on the text of Genesis.

"It is always the same—in order to read such ingenious conjectures into the account of Moses, what he has written must be forgotten. Most certainly, if he had desired to express the ideas imputed to him, he would have made it clear; since he spoke to be understood, and he was not addressing refined or keen intellects. At least he would have left us some indication, some key, to help us to the discovery of these subtilties in his words. Far from this, his clear pronouncements leave no room for these too learned glosses." [3]

[1] *Dublin Review*, April 1881. The translation is borrowed from Zahm's book, *Bible, Foi et Science*, 1897, translated by Flageolet.

[2] *Manuel biblique*, pp. 469, 10th ed.

[3] *Questions actuelles d'Ecriture sainte*, p. 167

These remarks are certainly just. But they tell against P. Brucker's concordism as well as against the various forms of idealism which he combats. In fact the day-periods may have been as far from the mind of Moses as the idealist system.[1]

Conclusion.

1. It is not possible any longer to doubt the slow and progressive formation of the universe by natural action and physical forces. If the first phases are hypothetical, from being beyond the scope of observation, at least the geological phases, with the long duration they require, are certain.

2. For the believer the cosmogony of the Bible is inspired in its totality and teaches no errors. But we may seek to know what it purposes to teach.

3. It certainly teaches us the fact of the creation, and the dogma of the One and Personal God; and consequent upon this the religious duties of man towards his Creator. . . .

[1] For some years, certain Catholic exegetists have given a new form to idealism. It is well known that the sacred writers as well as the Fathers of the Church, have adopted the scientific ideas of their own times, and by their means supported the religious truth which they sought to transmit. These data, borrowed from the physical world, and the science of cosmogony, do not become of more objective value from the fact of the inspired writers having utilised them. But amongst the ancients, there were also cosmogonic ideas; and a history as well as a description of the universe had been made. When the sacred writer affirmed and propagated the dogma of God the Creator, he thought that he could not do better than borrow from his surroundings, and use the received cosmogony; he purified it from polytheism, and adapted it to his ends, but communicated no new scientific value to it. According to this hypothesis, the tale of the creation should be taken in the literal sense, but without its scientific, and strict historical setting. This *critical literalism* is thought by many to go too far. As it has not been taught in the Catholic schools, we abstain from developing it; it is mentioned only to show that its existence is known. The elements of it may be found in many authors. Fr. Lenormant, *Les origines de l'histoire d'après la Bible et les traditions des peuples orientaux;* Loisy, *Les études bibliques;* d'Hulst, *La question biblique;* Lagrange, *L'Hexaméron*, in the *Revue biblique*, July 1896.

4. With regard to the framework,—that is, the account which encloses this teaching,—Catholic writers hold three opinions concerning it.

(*a*) With the Concordists this framework or recital is strictly historical, in which the days represent the phases through which the earth passed, up to our day, in the order in which they occurred.

(*b*) With the Idealist, it is a framework purely artificial, in which the sacred author has placed the most prominent of God's works, making use of six pictures or representations, to figure the six days of the week.

(*c*) According to the Critics it is a framework borrowed from popular tradition, and the cosmography in vogue in the time in which it was written, adapted and purified, so as to teach religious truth, and the Sabbatical rest.

It need not be a matter of surprise that orthodox exegesis invests itself in more than one form, at one and the same time; this variety of opinion has existed from the commencement of its history. Until the Church pronounces definitely on the subject, the various theories have the same value as the reasons used by their authors. In any case they affirm very positively the divine origin and infallibility of the text.

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CHAPTER II

THE ORIGIN OF LIFE

I. *The Question Stated.*

THE object of this chapter is to search into the beginning of life on the earth. If it be true, as philosophers and scientists are unanimous in affirming, that at a very remote period no living creature moved on the surface of the earth, how—by the intervention of what force—did inert molecules become suddenly endowed with vital power? It is not a question, at least not here, whether all forms of life could have been derived from one primitive source, or have descended from a variety of primitive types. The question now proposed is as follows. In what way was the first living protoplasm formed?

The Bible gives us an answer: God created all Life. If the answer is certain, it does not seem sufficiently definite for some interpreters. They say, is not God the Author of life as the First Cause only? When He created all the elements of the universe, did He not make them capable of combining under favourable conditions into some form of life? Might it not rather be said that God is the source of life by carrying out the synthesis of the first animated substance, and in framing special laws for the transmission of life, and the evolution of its various forms? Whichever supposition we hold, the sacred text demands that we should revert to God as Creator.

What says science on the first origin of living beings? We must carefully distinguish in speaking of science, between the experimentalists who register facts, and the philosophic party who, going beyond facts, endeavour to

rise to their causes. The scientist tries in vain to keep within the region of experiment; by his very nature he is led into the more transcendent region of causes.

Experiments are evidently powerless to solve the question with which we are occupied. Doubtless we speak of a fact, but a fact of which we have no evidence. Even had we discovered with any degree of certainty the trace of the first living creature, these traces might tell us its nature and relative age, but not its mode of origin. The facts, therefore, which fall under our actual experience, only form the basis on which to build up a philosophical argument by which to arrive at the origin of life.

In the same measure that agreement is easy as to the nature and truth of the experiments, so is the disagreement accentuated in the conclusions drawn by induction.

The materialistic school tells us that life *must have* commenced spontaneously, with no intervention from without, under the sole physico-chemical action alone; apparently it is a "necessary postulatum," a "philosophic necessity"; facts no doubt tend to prove the contrary, but science can only deal with the universe according to the forces inherent in the universe.

The spiritualistic school, starting from the same facts, after a closely reasoned process of deduction, recognises the necessity of an intervention from without, and apart from the world, to create Life; it believes that science is honoured inasmuch as it bows to the supreme power whenever it meets with it.

Is it necessary to declare the vast importance of this question? What interests the one side and disturbs the other is, that there is a palpable proof of the existence of a personal and acting God, and that God becomes an object of human science.

The path to be followed is clearly traced. Let us question the facts and then reason on them—first reasoning on the original source, then on the beginning of living beings.

II. *The Teaching of Experiments.*

In the present state of science, we may state as incontestable the following fact; not only has the spontaneous passage from inert matter to a living organism never been observed, but it is well established that all known living substances, even the lowest, proceed by way of generation, from similar substances already endowed with life.

It is only after long hesitation, and most patient researches that science has been able to assert such an important fact.[1]

We hope it will be agreeable to our readers that we should briefly rehearse the results of the investigations which have dethroned the old hypothesis of spontaneous generation.

1. *The time previous to the labours of Pasteur.* — Men thought, in ancient times, with Aristotle, that many beings, whose origin was unknown, were formed, without parents by the force of inanimate matter. The mud of rivers, or all putrefying substances seemed capable of spontaneously organizing and producing reptiles, fish, insects, worms and other of the smaller creatures. Hence came the celebrated saying "Corruptio unius generatio alterius."[2]

[1] "Les idées qui apparaissent dans les sciences présentent deux aspects opposés dans leur développement; les idées vraies, partant le plus souvent d'un très petit nombre de faits simples bien observés, grandissent à mesure que les connaissances augmentent et s'étendent de plus en plus; les idées erronées, embrassant ordinairement dès l'abord un grand nombre de faits obscurs et mal vus, s'amoindrissent au contraire et disparaissent en raison directe des progrès de la science. La question des générations spontanées s'est trouvée dans le dernier cas, en ce sens qu'elle s'est toujours circonscrite de plus en plus devant les lumières de l'expérience. D'abord étendus aux mollusques, aux articulés et jusqu'aux vertébrés, les cas de générations spontanées étaient depuis longtemps relégués dans les parties les plus obscures de l'histoire naturelle, c'est-à-dire dans les animaux infusoires." Claude Bernard. (Rapport sur le prix d'Alembert attribué à M. Pasteur. *Comptes rendus de l'Académie des Sciences*, 1862, t. lv. p. 977.)

[2] "Cette formule, très vraie dans le sens général qu'une substance n'est jamais détruite sans qu'il en naisse une autre, signifiait alors que la putréfaction d'un être vivant en engendre un autre. On peut en sourire aujour-

The Middle Ages accepted the spontaneous birth of certain creatures as a proved fact. But the powerful reasoning faculties of the Christian philosophers interpreted the fact in a fashion very different from the materialistic view of life. St Thomas Aquinas does not deny spontaneous generation, but he severely reprimands Avicenna who attributes it entirely to the power of matter: in the eyes of the Angelic Doctor, if matter produces life, it is in virtue of a special power given by God, and acts under celestial influence.[1]

In the seventeenth century, Van Helmont (1644) gave recipes for obtaining adult mice and scorpions without parents.[2] However the spirit of observation became developed, and in the seventeenth century the experiments of Redi[3] and Swammerdam[4] dissipated many fables. Redi in 1698 proved that the maggots seen on putrid meat were the larvæ of the eggs of the fly. In order to preserve the meat sound it should suffice to cover it with fine gauze. This Redi did; the flies being kept from the meat, neither larvæ nor worms appeared.

Thanks to these experiments the idea of spontaneous generation was put aside for the time being. But very soon the microscope made the existence of a new world of minute creatures known. The state of ignorance which

d'hui, et pourtant des savants modernes, comme M. Trécul, enseignent qu'avant d'abandonner un corps organisé, la vie recueille ses forces pour en produire un autre de nature différente." (*Comptes rendus*, 1872, t. lxxv. p. 1161.)

[1] St Thomas, *Sum. Theol.*, 1 p. q. 71, art. 1, ad 1um. "Non quod aqua aut terra habeat in se virtutem producendi omnia animalia, ut Avicenna posuit: sed quia hoc ipsum quod ex materia elementari virtute seminis vel stellarum possunt animalia produci, est ex virtute primitus elementis data."

[2] "Creusez un trou dans une brique, mettez-y de l'herbe de basilic pliée, appliquez une seconde brique contre la première, . . . exposez les deux briques au soleil, et, au bout de quelques jours, l'odeur de basilic changera l'herbe en véritables scorpions." Van Helmont, a Belgian doctor.

[3] Redi, medical attendant to the Grand-dukes of Toscane.

[4] Swammerdam (1637-1680), a doctor of Amsterdam.

prevailed with regard to their propagation, renewed the old ideas concerning generation without parents. It was the Abbé Spallanzani (1729-1799) who was the most victorious in attacking and overthrowing these ideas.[1] He clearly saw from one fact, the error against which the advocates of spontaneous generation would have to guard. The ears of diseased wheat when thoroughly dried, appeared to be merely inert dust: but a drop of water thrown on this dust, even after many years, was sufficient to reanimate life; life then was not extinct but only suspended. "How often," he said, "we take for spontaneous organisation what is nothing but a reawakening of latent life."[2] Encouraged by this success, Spallanzani tried to prove that microscopic life, appearing in infusions exposed to the air, was due to atmospheric germs. With this end in view, he enclosed in hermetically sealed vessels, some infusions, rendered sterile by boiling. It is true these experiments were not always successful, because sufficient means were lacking to eliminate all sources of error; he demonstrated, however, that the expected results followed in proportion to the required conditions being fulfilled.

Other naturalists in France and Germany took up the studies of Spallanzani and continued them with such success, that in the middle of this century, the hypothesis of spontaneous generation was only regarded as an exploded opinion.

In 1858 M. Pouchet, Professor of Zoology at Rouen, reopened the dispute. He affirmed that he had seen infusoria come into life spontaneously in a fermentable liquid (previously rendered sterile) which was brought into contact with air deprived of germs. Many members of the Academy of Sciences (amongst others, Claud Bernard, de

[1] En même temps, l'hypothèse des générations spontanées était soutenue en Angleterre par Needham, prêtre catholique (1713-1781), celui qui fonda l'Académie des Sciences de Bruxelles.

[2] *Cf.* D. Cochin, *L'Évolution et la vie.*

Quatrefages, Payen,) pointed out to M. Pouchet that there were causes of error, against which he had not guarded. But as M. Pouchet still made the same assertion, in order to throw light on a question of such importance, the Academy proposed that its examination should form the object of a prize (1860). It was then that M. Pasteur first entered on the scene.[1]

2. *M. Pasteur's first efforts when confronting Messrs Pouchet, Musset et Joly* (1859-1865).—M. Pouchet thus

FIG. 20. Various kinds of microbes and ferments. To the left are the different forms which microbes take. To the right, A, B, C, D, E, are various states of the *Bacillus mesentericus vulgatus.*—F, The comma-like bacillus of cholera.

stated the question. It is a fact, everywhere, and at all times, that a fermentable liquid, which is exposed to the air, becomes covered with mildew and filled with infusoria (Fig. 20). Now the few germs disseminated in the air, are insufficient to account for such a wonderful fecundity of life.

[1] "On peut difficilement se figurer la vivacité de ces batailles, à la suite desquelles, vaincue par l'évidence, accablée sous le poids de la preuve expérimentale, l'antique hypothèse, la chimérique illusion de la génération spontanée a battu en retraite devant la triomphante doctrine des germes, qui a renouvelé la science et qui est entrée en possession incontestée de l'avenir." (Discours de M. Dupuy, ministre de l'Instr. publ., au 70e anniversaire de M. Pasteur, célébré à la Sorbonne, le 27 décembre 1892.)

Moreover, if a current of air, free from all germs, be carried to a putrescible broth, already sterilized by boiling, life will become apparent. M. Pouchet exhibited experiments, as numerous as they were varied, in support of this thesis.[1] Therefore, he concluded, life can appear without germs, and spontaneous generation is experimentally demonstrated.

M. Pasteur took upon himself the burden of proving that the true cause of all putrefaction are the germs in the air. Two series of experiments enabled him to establish in an undeniable manner the two following facts. 1st, a pure air, completely deprived of germs, does not cause putrefaction in a fermentable liquid, thoroughly sterilized. 2nd, pure air, not deprived of germs, does not necessarily produce putrefaction in a fermentable liquid, previously sterilized, because the germs are not sufficiently numerous.

(*a*) *Pure air, entirely deprived of its germs, does not produce fermentation in a putrescible liquid, previously sterilized.* —M. Pasteur first used a solution of sugar and albumen; afterwards he had recourse to different kinds of infusions; he also used blood, milk and urine, etc. These liquids were sterilized, or deprived of their germs by boiling.[2] Since he followed the same methods as M. Pouchet, he could not be accused of destroying the generating powers of the infusoria, nor of disturbing the basis on which the argument rested. In these preliminary operations he was enabled to draw attention to the errors against which M. Pouchet had not sufficiently guarded himself. In fact the destructive effects of high temperature act very unequally on the germs. At times they were looked upon as dead, when life was only suspended and latent. Certain germs are surrounded by coagulated matter which protects them from the heat; these were found especially in the hay and

[1] *Comptes rendus*, 1860, t. l. p. 532.

[2] La plupart du temps, l'ébullition de cinq minutes suffisait pour stériliser les milieux . . .; pour le lait, il remarqua qu'il fallait chauffer jusqu'à 112 degrés sous la pression de 1½ atmosphère. (*Comptes rendus*, t. l. p. 303.)

the other substances which M. Pouchet and his adherents preferred to use for their infusions.

The mercury, full of germs, which M. Pouchet used without having sterilized it, was another source of error. He reversed a small bottle of sterilized water, and plunged it into a vessel of mercury; then through the mercury he introduced pure oxygen, and a small bundle of sterilized hay. But as M. Pasteur clearly showed, the surface of the mercury was contaminated by atmospheric dust, therefore the liquid in the bottles would take up germs when coming in contact with the mercury. There was nothing surprising that germination took place in M. Pouchet's experiments.[1]

After being assured of the complete destruction of the germs in fermentable liquids,[2] M. Pasteur next endeavoured to use air, which although normal, should be perfectly pure. He had only to destroy those germs which the atmosphere always carries in suspension. To attain this end he caused the air to pass through a tube of red hot platinum. The germs perished in the passage, without any alteration in the composition of the air; no life appeared in the flask after being thus prepared. Lest he should be accused of depriving the air of its plastic force from over-heating, M. Pasteur then resolved to eliminate the germs by simple filtration; to filter the air, he placed in small tubes, some-

[1] *Cf. Histoire d'un savant par un ignorant*, Paris, Hetzel, 1883.

[2] Il faut remarquer que les germes résistent inégalement au pouvoir destructeur de la chaleur. M. Doyère a prouvé que les Rotifères, les Tardigrades, peuvent subir longtemps la température de 100° et au delà, passer à l'état de poussière inerte, sans perdre cependant la faculté de se ranimer. M. Gavarret constate le même phénomène chez certains infusoires qui, après avoir été soumis à une température où tout animal périt d'ordinaire, pouvaient encore revenir à la vie. Certains êtres laissent suinter de leur corps une matière coagulable qui leur sert de gaine protectrice contre les agents destructeurs. M. Coste a découvert qu'on les rencontre surtout dans le foin et dans certaines substances choisies le plus souvent pour leurs infusions par les partisans des générations spontanées. Ces kystes ne sont pas toujours arrêtés par les filtres : ils sont assez ténus pour traverser même le papier. Le mercure, les filtres de coton, etc. . . . se laissent traverser par ces germes. (*Cf.* Milne-Edwards, *Rapport sur la zoologie*, Paris, 1867, p. 33.)

times cotton-wool already sterilized by heat, sometimes asbestos previously calcined; through these the air was passed. Afterwards the natural air brought in contact with the fermentable liquid produced no putrefaction.

In certain very rare cases, manifestations of life showed themselves; but these exceptions did not shake M. Pasteur's faith in his thesis; for if M. Pouchet had been correct, life would have manifested itself in *all* the experiments; as in all cases normal air came in contact with fermentable liquid; on the contrary, it is easy to understand, that, seeing the difficulty of killing and stopping all the germs, fermentation should have been sometimes produced.

In order to demonstrate clearly that the cause of fermentation not being produced, was owing solely to the fact that he had eliminated the germs from the air, M. Pasteur took a few shreds of the cotton-wool and of the asbestos on which some germs had remained, and threw them into the sterilized liquid; directly the seed was deposited, germination began. He rendered this fact still more evident to the senses by elongating the neck of his glass vessels, and making a twisted tube, so that the air had to pass through many sinuosities before coming in contact with the liquids. In one set of flasks he caused the air to come promptly and directly; many were covered with mildew; the air had come in too suddenly to deposit all the germs on the surface of the tubes. In another set of flasks he took care that the air should travel very slowly; all remained unaffected, because the germs rested on the surface of the tubes. The proof that this was the true cause of the sterility of the flask was shown, by M. Pasteur causing some of the liquid to come in contact with the walls of the tube, when germination followed at once, after he had brought the fermentable matter in contact with the germs.

By virtue of these facts it became possible to agree with Tyndall's conclusion: "If some beans were seen coming up in a garden, it could be affirmed without hesitation that a

seed had been sown in that spot; so when liquid becomes putrid, it is possible to assert with the same assurance that the air has sown germs" (Fig. 21).

(*b*) But M. Pasteur made his conclusions still more striking by demonstrating that (taking into account the small

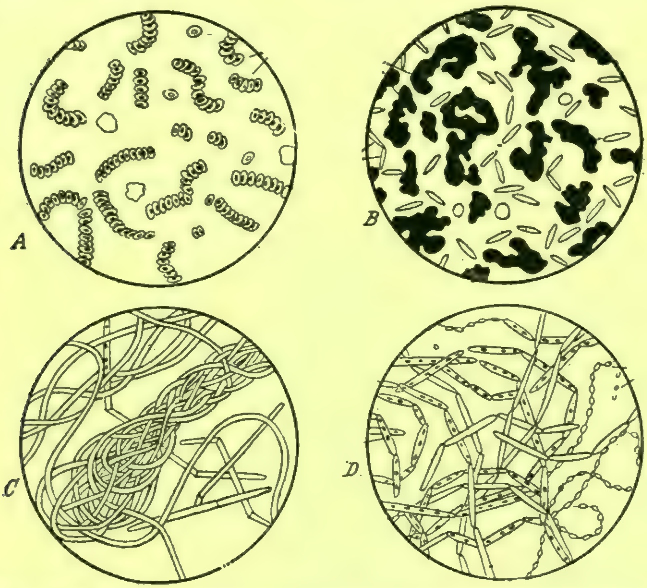


FIG 21.—The bacillus of carbuncle (bacillus anthracis). A, a drop of blood with normal corpuscles, before the invasion of the bacillus. B, a drop of blood of an animal which died of carbuncle. C, bacillus of carbuncle cultivated in beef-tea. D, bacillus and spores.

number of germs scattered in the air) *the natural air does not necessarily cause putrefaction.*

The principles which M. Pouchet enunciated led to the following logical conclusions: "If air be taken, from whatever spot, and placed in contact with sterilized but fermentable broth, there will infallibly be a manifestation of life." But M. Pasteur, on the contrary, affirmed clearly: "That it is always possible to abstract a certain quantity of air from any given spot which has not undergone either physical

or chemical change, and yet which may be totally unfit to produce any alteration whatever in a liquid eminently putrescible." M. M. Pouchet, Musset, and Joly wrote to the Academy of Science saying that this assertion was erroneous, because contrary to their own experiments. Then M. Pasteur defied them to produce experimental proofs of what they affirmed. They accepted the challenge. "If a single flask remains unaltered," said Messrs Joly and Musset, "we will loyally acknowledge ourselves defeated." "I assert," said M. Pouchet, "that from whatever quarter of the globe I should take a cubic decimetre of air, as soon as I had placed it in contact with a putrescible liquid enclosed in a vessel hermetically sealed, it would become without fail filled with living organisms."

The Academy appointed a commission, before whom the experiments of both sides were to be repeated. After many conferences, which were reported at full length by M. Balard in his Memoir of Feb. 25, 1865, Messrs Pouchet, Musset, and Joly refused to face the ordeal and retired. M. Pasteur remained alone before his judges.[1]

He began by establishing the truth of the experiments he had already made. He showed some glass vessels in which fermentable liquids had been brought in contact with the air, some on the Jura and some on Mont Blanc. Many were unchanged during the course of three or four years. The neck of one of the flasks was broken, and the air of the laboratory caused mildew, which appeared in little flakes at the end of three days.

Afterwards fifty-six glass vessels previously prepared for these experiments were opened in different places, where it was supposed the composition of the air would vary considerably. Nineteen received the air of the great amphitheatre of the Museum; nineteen were opened on the

[1] Voir l'intéressant rapport de M. Balard, *Comptes rendus*, 1865, t. lx. p. 384. Étaient membres de la commission : Flourens, Dumas, Brongniard Milne-Edwards, Balard, rapporteur.

highest point of the dome; the eighteen others had been taken to Bellevue, and placed in the middle of a lawn under a group of large poplar trees. Of the first set, fourteen of the flasks remained sterile; thirteen in the second; one single flask only remained unaltered in the third, the atmosphere being so rich in germs at Bellevue. Thus the truth of M. Pasteur's proposition was demonstrated, that natural air does not necessarily produce life in a medium favourable to germination.

From all these experiments he came to conclusions quite opposed to generation without germs. The old saying "Omne vivum ex vivo" was verified in the world of the infinitely little, as well as with creatures visible to the naked eye.

The dispute might have been considered settled, at least on the ground to which M. Pasteur had carried it, when it was revived by a dissertation of M. Bastian, the holder of a London medical degree. The Doctor considered that he had found the physico-chemical conditions favourable for producing life without germs. "My observations," he said, "were made on urine heated to boiling point. In order to bring about the production of bacteria, I brought chemical influence to bear by potash and oxygen, and physical by a temperature of 50 degrees." M. Pasteur accepted the new challenge which was offered to him.

Previously to appearing before the commission appointed by the Academy, he made known to M. Bastian three causes of error, against which he had not guarded himself. The English Doctor understood his failure and retraced his steps to London (1877).[1]

[1] "L'Allemand Butschli, par un mélange d'huile et de matière savonneuse, a réalisé, ou plutôt crut réaliser du protoplasme. Faire la statue d'un homme n'est pas faire un homme. Le protoplasme de Butschli peut ressembler extérieurement au protoplasme vivant, mais il en diffère d'abord essentiellement par la composition chimique, puis en ce que le protoplasme est incapable de se multiplier, de se différencier. Bref, il est dépourvu des propriétes vitales. Butschli a donc fait une statue de protoplasme." L. Picard, *Chrétien ou agnostique*, p. 19, note.

3. *The discussions between M. Pasteur and Messrs Frémy and Trécul.*—It was in the course of these grand studies on fermentation that M. Pasteur entered on his attack on spontaneous generation. He had discovered that fermentation is a function of life, and that the phenomenon is produced in fermentable liquids by living cells of yeast or fermentable matter. For instance, the *must* of grapes ferments owing to a microscopic organism which lives in the mass, and which, when sheltered from the air, reduces the sugar to alcohol and carbonic acid. Whence comes this organism? According to M. Pasteur, some germs, scattered in the air, deposit themselves in summer on the small seeds, which first compose the branches, then in autumn, when the grapes are crushed, the germs mix with the juice and cause fermentation (Fig. 22).

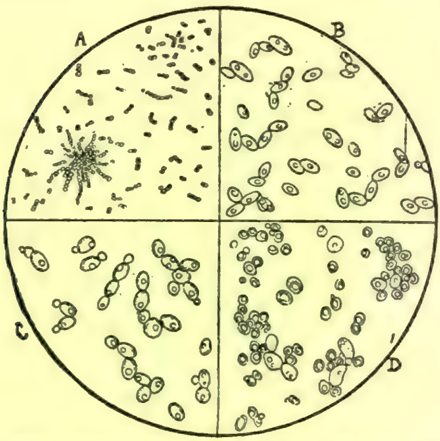


FIG. 22.—Ferments. A, of vinegar. B, of wine. C, mycoderm of new wine. D, mycoderm of old.

This theory, so beautiful in its simplicity, was laid before the Academy of Science in 1872, and M. Frémy attacked it vigorously. The learned professor of the Museum argued as M. Pouchet had done. "Fermentation, produced at all times and in all places, cannot be influenced only by atmospheric dust. The fermentable matter, similar to the direct principles of vegetable life, is created by the organization itself." "Doubtless," he added, "a living organism could not be produced by inert matter, but it can by organic matter. The fermenting matter of wine, for instance, is created by the cells of parenchyma which constitute the juice of grapes."

Thus was the old thesis of spontaneous generation reproduced under a new form.

To this theory of M. Frémy,[1] which was defended by M. Trécul,[2] the name *hemiorganism* was justly given, because they taught that a living being is born spontaneously in the midst of matter already partly organised. To refute them, M. Pasteur undertook fresh experiments, the delicacy and accuracy of which far surpassed the former ones.[3]

He had to prove that the alcoholic fermentation of wine is due to the atmospheric ferment germs. In forty flasks prepared for this purpose he introduced the filtered *must* of grapes rendered perfectly clear. After having been boiled, the liquid remained unaltered, although it had communication with the outer air through the twisted necks of the bottles.

Then he washed a portion of a bunch of grapes in a few cubic centimetres of water; with a microscope he was able to detect in the liquid, numerous organised corpuscles similar to the ferment cells. But that was not sufficient.

He then divided the glass vessels into four sets. In the first he put nothing, and the *must* of the grapes remained unaffected. The flasks of the second set received a few drops of the liquid in which the grapes had been steeped; at the end of forty-eight hours they were full of alcoholic fermentation. They had received the seed, and germination was the result.

In the third set M. Pasteur introduced a few drops of

[1] Frémy, professeur de chemie, fut le successeur de Gay-Lussac au Muséum.

[2] Trécul fut professeur de botanique au Muséum. M. Trécul crut avoir démontré la naissance de ferments organiques "dans l'intérieur de cellules fermées et à parois épaissies, occupant encore leur place naturelle dans le fragment de rameau auquel elles appartiennent." Il donne de la génération spontanée la définition suivante : "Une opération naturelle par laquelle la vie, sur le point d'abandonner un corps organisé, concentre son action sur quelques-unes des particules de ce corps, et en forme des êtres tout différents de celui dont la substance a été empruntée." (*Comptes rendus*, 1872, t. lxxv. p. 1161.)

[3] *Comptes rendus*, 1872, t. lxxv. p. 781.

the same liquid in which the grapes had been steeped, after having boiled it. One single flask fermented, the others remained unaltered. It is so difficult to eliminate all causes of error that the fermentation of one flask in ten was very natural. In the last remaining ten flasks M. Pasteur introduced the juice of the grape taken before the bunches had been pressed; in this last set only one flask fermented.

The conclusion was evident: the *must* of grapes will not ferment by itself. The organic matter which produces fermentation in the *must*, which is in the vat of the vintage, comes from the exterior and not the interior of the fruit.

To this assertion M. Frémy and Trécul made great opposition.

They offered several objections, which M. Pasteur hastened to overcome by the further explanation of his own experiments. In order to reply with still greater assurance, in order not to destroy by boiling the fancied power of generation of the *must* of the grapes from heat, in order to have a sufficient quantity intact of matter productive of life, and, finally, not to alter the cells of the parenchyma, he had recourse to the following plan.

In his vineyard at Arbois he caused a greenhouse to be constructed over some vines. As he had noticed that the cells of the fermenting matters were only deposited on the grapes in July, he covered the growing bunches with cotton-wool in June. In spite of this the fruit ripened. But as the cotton filtered the air, the organic corpuscles were stopped, and could not reach the outer covering of each grape.

Autumn having come, the grapes were pressed with every necessary precaution to keep them sheltered from external germs. No fermentation appeared. And yet all the conditions required by M. Frémy were fulfilled; the liquid was abundant; the cells of the parenchyma were in the same state as in an ordinary vat; and no heat by boiling had

altered the power inherent in the organic matter. One could only come to the conclusion that the living fruit was incapable, in itself, of generating the organic fermenting matter without external germs.

Thus hemiorganism was vanquished, thanks to the patient researches of M. Pasteur.

4. *Tyndall's Experiments.*—The clever English experimentalist Tyndall, was anxious to verify all the results obtained by M. Pasteur. By a very ingenious arrangement he made the germs of the air and their action on fermentable infusions evident.

"Construct a little room supplied with a door, window, and shutters. Cause an opening to be made in the shutters, through which one of the sun's rays can pass. Shut the door and the window, in such a way that no light can come in except through the hole in the shutter. Traces of the sun's ray will at first be very clear and distinct in the air of the room. If all movement be avoided the luminous path becomes more and more feeble; at last it will disappear entirely. What rendered the ray visible at first? It was the dust floating in the air, which thus lighted, becomes as palpable to our senses as dust placed in the hollow of our hand. In the still air the dust falls little by little to the ground, or remains on the walls and ceiling, until at last by this automatic process of cleansing, the air becomes completely deprived of the matter which it held mechanically in suspension.

"If we cut off a piece of steak, and leave it for two or three days in hot water, we shall extract a sort of concentrated beef essence. When the liquid is boiled and filtered we can obtain perfectly clear beef-tea. Let several vessels of the beef-tea be exposed to the air of our room which has been deprived of its suspended matter; then let other vessels containing the same liquid be placed in air filled with dust. At the end of three days, each vessel of the second set would have a bad smell, and, examined with

a microscope, would be found to abound in bacteria of putrefaction. But at the end of three months or three years, the beef-tea shut up in the room would be found to be as clear, as well-flavoured and as exempt from bacteria as at the moment when the vessels were first introduced into the room. There is absolutely no difference between the exterior and the interior air except that the one is free from dust, and the other filled with it.

"Let us continue the experiment in the following manner. Open the door of your room and allow the dust to enter; at the end of three days you will find each vessel swarming with bacteria, and in a state of active putrefaction. Construct fifty rooms instead of one, and use all imaginable extracts, either from wild or domestic animals, or from plants of the most varied kind. If in all these cases you find that the dust has invariably produced a development of bacteria, whilst on the other hand you see that neither the air without dust, nor the alimentary infusion, nor these two elements combined, could produce this development; you will arrive, in an irresistible manner, at the conclusion that the dust of the air contains the germs of life which have shown themselves in all your previous infusions."[1]

At the end of these experiments, Tyndall explained clearly, why the brewer places yeast in the wort, or extract from the barley to make beer. What would happen if the malt were exposed to the action of the atmospheric dust? It would again ferment, but there would be every chance of its not yielding the desired result, since there would be added to the germs of the yeast many other causes of fermentation which would interfere with the desired end.

For more than a year Tyndall gave himself up to minute and close investigations[2] on the action and vital resistance

[1] Extrait d'un discours prononcé à Glasgow, en 1876. Voir *Cosmos*, t. xlii. p. 57.

[2] Voir les rapports de Tyndall résumés dans le Cosmos, t. xliv. pp. 39, 118.

of putrefying and infectious organisms. He experienced many failures, but his misfortunes as well as his successes, both led him to the same general conclusion, that all fermentation, or putrefaction, came from pre-existing germs.

After so many efforts, he was justified in making the following declaration. "In experimental science there is no conclusion more certain than this. In the presence of these facts, it would be absolutely monstrous to affirm that these swarms of bacteria were spontaneously generated."

Virchow, holding a German scientific degree, said also: "Not a single positive fact is known which establishes that spontaneous generation has ever taken place. Those who think otherwise are contradicted, not by theologians, but by the scientist. Hæckel, the ardent professor of Jena, makes the same avowal, although he holds spontaneous generation, because he considers it an indispensable *postulatum.*

In France, the Academy of Science has many times, by impressive judgments, confirmed the expressed opinion of the perfect accuracy of the results made known by Pasteur.

The reader will pardon us for having insisted so much on the experimental facts; too often books are contented to make a summary allusion to them. Besides the interest attaching to them, they make the necessary foundation from which to reason.

We have now firmly established the following dictum: *that all known living substances, even the most humble, proceed by generation from similar substances already endowed with life.* Experience does not enable us to go beyond this general formula.[1]

[1] Il ne sera pas inutile d'ajouter ici quelques témoignages.

Littré: "La vie, telle qu'elle se montre à nos yeux, ne se propage que par parents; nous n'avons aucun droit expérimental de faire figurer à l'origine une propriété vitale, avec une action qu'elle n'a plus aujourd'hui." (*Génération spontanée et Transformisme.*)

Flourens qualifie la génération spontanée d'hypothèse "très commode et très absurde." (*Longévité.*)

W. Thomson (Lord Kelvin): "La science fournit une multitude de preuves

§ 3. *Spontaneous generation judged by reason.*

It belongs to the domain of reason to search out what experiments alone cannot discover. Is not life perhaps produced spontaneously, in the lowest degrees of organisation, in too elementary a state for our eyes to be conscious of it? Is not matter capable in itself of the power of organisation, under the sole influence of physico-chemical forces? These are the questions we have to consider, if we would establish our right to the thesis that life is only produced by life.

1. *The argument of Induction.*—Repulsed on the ground of experimental science, the partisans of spontaneous generation take refuge in the domains of hypothesis. "Without doubt," they say, "no beings have been seen to form themselves spontaneously, but that is no proof that life cannot be produced without germs. In fact the organisms which have been observed are very far from the outer confines of life; even the infusoria are very complicated. It is at the extreme limits only, at the borderland between the mineral and vegetable kingdoms, where we must look for the passage from inert matter to life. In the profound secrets of the high seas, or even perhaps in our own flasks used for the experiments, combinations of elements might be at work, which might form the first rudiments of life; the changes may not be patent to our senses, only because they lacked rapidity of movement."

The elementary principles of induction lead us to an entirely opposite conclusion to this hypothesis. The laws of nature are universal and constant. This they would cease to be if life were not produced in an uniform manner. Thus if creatures exist so small as not to be cognisable,

invincibles contre l'hypothèse de la génération spontanée, ainsi que vous l'avez entendu de la bouche de mon prédécesseur dans ce fauteuil, M. Huxley. Un examen minutieux n'a, jusqu'à ce jour, découvert aucun principe de la vie que la vie elle-même." (Discours d'ouverture de l'assemblée d'Edimbourg en 1871).

Hæckel lui-même avoue que "les essais d'autogenie (génération spontanée) n'ont jusqu'ici donné aucun résultat positif." (*Histoire de la création naturelle*, p. 274, traduction, Paris, 1884.)

or apprehended by our instruments, their origin must still be analogous to that of those with which we are familiar. Would the learned scientist be the one to throw doubt on the constancy and universality of the laws of nature? Is not the highest ambition of modern science to find general formulæ which embrace all the facts of the same kind? Is not the substitution of one single formula for manifold formulæ considered a scientific triumph? It would need clearly verified facts to prove that in one group of phenomena nature had two methods of procedure; and these facts would become legitimate objects of keen opposition.

Now in the question which occupies us, all the known facts are favourable to the single law that life is produced by life. For some time it was thought that facts tended to show that nature acted in two ways in the formation of living beings; but the instinct of the scientist decided that they were faulty. Pasteur brought them all within the bounds of the general rule. Since at every discovery of smaller creatures the heterogenist theory always revived and was vanquished, we have the right to conclude that if still smaller and lower creatures were discovered their origin would present no points of difference.

To elude these consequences it would be necessary to produce facts on their side, or good and sufficient reasons. Let us examine the facts and the reasoning.

In 1868, it was really thought that the first formation of life had been discovered. During the expedition of the *Challenger* a lump of thick matter or mucus was drawn up from the ocean, resembling an unformed protoplasm, which deposited itself in white flakes in the glasses used in the experiments. Hæckel thought that the elemental living being had come to hand in which the inert matter passes spontaneously into life; Huxley named it *Bathybius Hæckelis.* It was soon shown that it was not the long desired intermediary, but merely the ordinary precipitate of sulphate of lime, or else some mucus pressed out of sponges by the lead

of the sailors. Besides, even if it had been discovered that the Bathybius was a true protoplasm endowed with life, the question would have remained where it was. Whence came this living protoplasm? Was it endowed with life, or did it derive it from a previous protoplasm?[1]

According to Hæckel and Bastian, even if facts prove contrary to spontaneous generation, yet philosophy demands it.

Although Hæckel gives many forms to his reasonings, yet the basis of the argument is always the same. Life must have begun spontaneously on the earth, otherwise we must have recourse to the supernatural,—to God,—to the impossible. Now, as nature is as powerful as at the beginning, living beings should be produced now according to the same process as then. It is clear that this reasoning is faulty, for he takes for granted what ought to be proved, and that which is the object of the whole argument. The inverse order of the scientific method is followed. The true method consists in judging of the past, which is inaccessible to us, by the present, which we can observe. Hæckel takes the reverse way; he begins at a past which is entirely hypothetical in order to judge

[1] At the Congress of the British Association, held at Sheffield, Huxley gave the following explanation with regard to the *Bathybius*. "I shall ask permission to explain myself on a matter of personal import. Our president has alluded to a certain—thing—I really do not know whether to speak of it as a thing or otherwise—(laughter)—which you heard him call *Bathybius*, at the same time alluding to the fact, which was quite true, that it was I who had made it known: at least that it was I who had baptized it—(renewed laughter)—and in one sense I am its oldest friend—(peals of laughter). Some time after this interesting *Bathybius* made its appearance in the world, several excellent people took this little creature by the hand and made much of it. Thus things advanced, and I thought my young friend *Bathybius* was going to bring me to honour—(laughter); but it grieves me to say, that as time went on he in no wise fulfilled the promise of his youth. To begin with, as the president said, it was never found in the place where it was expected, which was very regrettable—(laughter)—and moreover, when it was found, many things not to its credit were said of it. In fact, I regret to have to confess it to you, but certain pessimists have gone so far as to assert that it is nothing in the world but a gelatinous precipitate of sulphate of lime taken up with organic matter—(laughter). . . ."

of the present, and judges of it in a way contrary to the most important indications of experimentation.

Bastian does not argue in a more reliable manner. Darwin's system, he says, is incontestable; now in this system, natural selection tends unceasingly to raise the lower creatures; after some time these inferior creatures would cease to exist, if nature did not produce others of the like kind spontaneously. All the assertions of this argument can be challenged. We do not consider that Darwinism, taken as a whole, cannot be disputed; far from it: even if the general idea of a common descent of all living beings were true, it would not follow that the reasons which support it are solid, nor that the explanatory hypotheses are exact. With regard to natural selection, Darwin himself has never taught the complete extinction of the lower creatures. In the struggle for existence it is certain that the fittest survive; but the fittest are not always the largest or most complicated; there are tiny elementary creatures, who find themselves protected and preserved by their minuteness, and by the facility with which they can accommodate themselves to any environment.

2. *The argument drawn from the nature of life.*—Hæckel felt that to affirm the spontaneous synthesis, and all the mechanism of the first protoplasm, an hypothesis would not suffice, it would be necessary to amend our conception of life; which he did as follows. "From the movements of the celestial bodies and the falling of a stone, to the growth of plants and the consciousness of man, all can be reduced and referred to the mechanical action of atoms." [1]

According to this monistic formula, there are no distinct orders of beings in nature; all the differences which have been observed are simple accidental modalities, caused by the movement of matter. All beings are accounted for by

[1] Hæckel, *Les preuves du transformisme*, Paris, 1882. La même idée se retrouve dans les autres ouvrages d'Hæckel, *Histoire de la création naturelle* Paris, 1884; *Morphologie générale*.

matter and movement; in minerals the state of being subsists by the stability of the elements; in living beings, the instability produces movements of nutrition. Following the physical forces which play their part, matter passes spontaneously from one state to another.

In the *Théorie nouvelle sur la Vie*,[1] M. Le Dantec tries to refer all vital phenomena to physical and chemical causes. If there is a difference of modality only, and of little importance, there is no necessity to have recourse to a foreign power, to bridge over so minute a distance. "If one of the monads was formed," he says, "all the other plasms would be derived by chemical evolution from it" (p. 194). Be it so. We will admit that from a living being once created, all other living beings could come. But this first living being, how did it appear? What Hæckel and others have said about the first combination of carbon in the primitive warm seas, is nothing but the result of their imagination.

Let us state the question clearly. Is the difference between living beings and minerals so small that one can admit a spontaneous passage of matter from the mineral state to a living state?

To answer the question we must first note those characteristics which are common to living beings and to minerals, then we shall better appreciate the differences.

The characteristics common to both.—The same *atomic elements* enter into the composition of the one and of the other. These atoms, not inert in themselves, but endowed with characteristic properties, ally themselves in every way; and by combination constitute themselves into bodies whose properties depend on the assembled elements. However, the constituent properties of the living world are very few, and always the same; carbon, oxygen, hydrogen and nitrogen, to which are generally added sulphur and phosphorus.

[1] Paris, 1896. C'est l'ouvrage le plus sérieusement étudié que nous possédions aujourd'hui sur la Vie. Même pour nous qui n'admettons pas la thèse de M. Le Dantec, il y a beaucoup à prendre. Le passage des faits étudiés à la conclusion dernière ne s'impose pas.

These elements combine under *the action of physical forces*; no chemical action takes place without being called into being by physical energy, without expending a certain amount of physical energy, without modifying the actual or potential state of this energy, either under the form of heat, or of electricity. Chemical operations take place in both the animal and mineral kingdoms, according to the same general laws.

It follows, therefore, that if the observer studies only the physical and chemical order of phenomena in living creatures, he can only place the living beings on the same line as the inanimate things. This is what physiologists and chemists appear too often to do; physiologists confine themselves frequently to enumerating the phenomena of movement, heat, electricity, weight, which certainly enter into the laws of physics and mechanics; the chemists, when analysing the protoplasms, which are always dead when in their hands, see only a very complex and extremely variable combination of a small number of simple elements.

But these movements, these forces, these elements, these combinations, in the living being are only the *material* support of life. Life, to be apprehended by itself, must be sought for from the other side,—amongst the differences,—for they exist.

The differences.—These differences are not all of the same importance. In noting those which are generally brought forward, we will try to find out their true significance.

(*a*) *Chemical composition.*—The composition of a living plasm is very complex. It is a collection of water, albuminous bodies, and of other substances, either dissolved, or in suspension when in the solid state. The albuminous bodies are confined to living creatures, Their synthesis is effected unceasingly by their cells in activity. Could this be done artificially by a chemist? The chemists have already made the synthesis of so many organic bodies, such as alcohol, sugar, ~~urine~~, that they hope to be able to manu-

urea

facture albuminoids. But, allowing that they could produce an albuminous clot, could they therefore make a living corpuscle? What they succeeded in producing might certainly have the same elemental composition as the dead protoplasm which they had analysed, but it would not be life. The living plasm has a quality which cannot be apprehended by analysis, but is essential, and which can only be given to matter by that which already possesses life.

The difference between the living plasm and the dead atom must necessarily be indicated by a difference in the chemical composition, since the chemical results are different. What is the difference? That is exactly what cannot be defined, as an analysis is only made of the dead organic matter (Fig. 23).

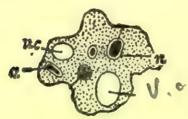


FIG. 23. — Unicellular Amœba, with an interior organism.—*n*, nucleus; *c*, corpuscle; *v c*, contractile vacuum.

(*b*) *Structure.*—The polycellular creatures present a very evident organisation; this exterior structure comes from the well ordered arrangement of the cellular units. But every cellule, every living plasm, has its special structure (Figs. 24, 25, 26 and 27). In every plastic mass two parts can be distinguished, which act differently when brought in contact with reacting colouring matter; the *nucleus* and the *protoplasm* (Le Dantec, p. 29). It has been proved that the monads of Hæckel which consist of an unattached protoplasm, with no nucleus, does not exist (*Année biologique*, 1895, p. 14). Frequently the protoplasm and nucleus present different aspects. And this structure of the cell is so essential to its life, that it is possible to kill the protoplasm by pressing it between two glass slides, its properties change, its movements stop, its nutrition ceases.[1]

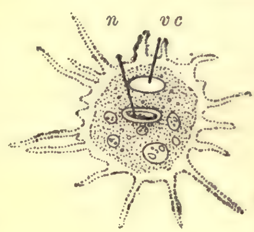


FIG. 24.—Amœba putting out Pseudopods over the whole of its surface.—*n*, nucleus; *v c*, contractile vacuum.

[1] Yves Delage, *Structure du protoplasme et les théories sur l'hérédité*, p. 749, Paris, 1895.

Minerals also present a structure, consisting of molecules invisible to the eye, and the crystalline structure, which comes from the molecular deposits. But the mineral structure is very different from the organic; in minerals the shape is stable, and it varies little in the same species; in the cellules the shape is essentially unstable, and it can be varied indefinitely in the same creature[1] (Fig. 28).

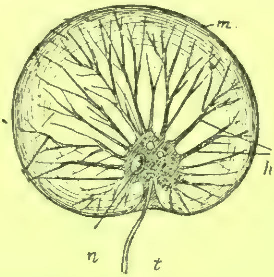
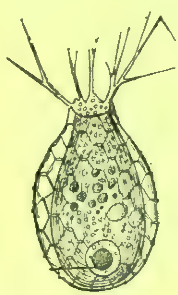


FIG. 25.—Jelly-fish.—*n*, nucleus; *t*, tentacle; *h*, hyaloplastic bands enveloping membrane.

Doubtless structure does not give life, but it is a condition of life. Thus, as previously said, it is by the shape, and also by a quality that does not meet the eye, that we distinguish a living protoplasm from a mineral. Is it possible to admit that physical forces are sufficient to cause matter to pass from one state to another, when the properties of each state are so far apart.



FIGS. 26, 27. — Amœbæ putting out Pseudopods at a single point on their surface.

(*c*) *Nutrition.*—Nutrition is a very complex phenomenon. Studied in the individual cellular form, we understand by it, the entrance of aliments, the digestion or dissolving of the aliments, and finally assimilation; this last operation alone really constitutes nutrition.

According to Le Dantec,[2] mechanical and chemical phenomena are sufficient to account for the entrance of aliments into the cellule, and their solution and diffusion in the proto-

[1] Vallet, *La vie et l'hérédité*, ch. ii., Paris, 1891.

[2] *Théorie nouvelle de la Vie*, Paris, 1896.

plasmic mass. The analysis of it is extremely instructive. But the act of assimilation cannot be reduced to a physical law. Le Dantec himself describes the process of assimilation.[1]

"Let us study a movable bacteria; we know that it is not in a state of independence with regard to chemical interference, that reactions take place between it and the broth in which it is found. We ought therefore to expect, from what we know of inanimate substances, to see it diminish, spent by the constant reactions. When alcohol burns, it is

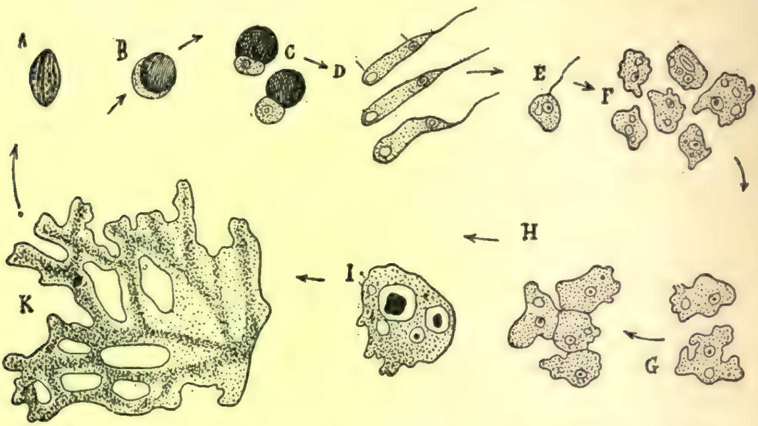


FIG. 28.—Different stages of mildew.—A, the spore;—B, I, successive stages; K, protoplasmic mass, the result of the fusion of several unicellular individuals.

consumed, because those parts which are in combination with the oxygen have formed water and carbonic acid. The inanimate body *a*, which is the seat of chemical reaction of whatever kind, is reduced by this reaction in the same proportion as those parts, which had reacted, have entered into the other chemical body.

"Now in our bacteria, it is the contrary that has taken place, it increases as it is observed. It would be very natural to suppose that this increased mass was produced by the addition of new matter, coming from the preceding

[1] *Théorie nouvelle de la Vie*, p. 112, et suiv, Paris, 1886.

reactions, and differing from that which existed at the commencement of the observations, in such a manner that the increase of the mass would be accompanied by the loss of some initial properties. A drop of mercury which is oxidized is increased in weight; but the result of this oxidation is no longer mercury, but a different body lacking its appearance and properties.

"With our bacteria it is quite otherwise. At the end of some time, it has attained certain dimensions, beyond which

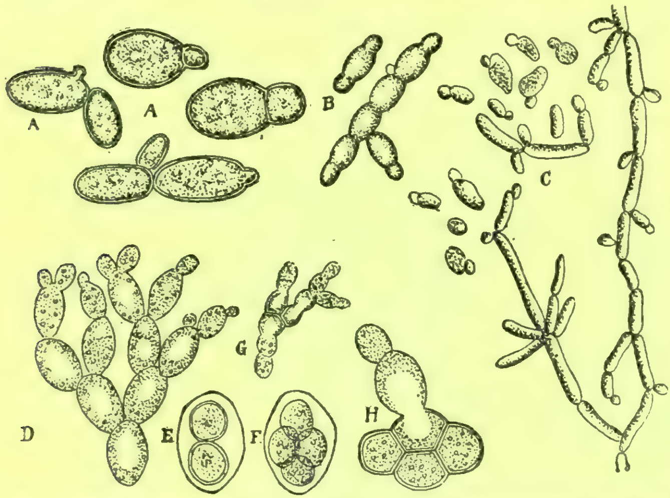


FIG. 29.—The chief ferments.—A, yeast of beer; B, Saccharomyces ellipsoidens; C, S, postorianus; D, budding of yeast plant; E, F, G, H, division and budding of yeast plant.

it cannot go, if it remain whole and in its condition of equilibrium; it therefore separates itself and becomes two bacteria, resembling itself.

"I use the words *resembling itself* advisedly: that is to say, possessing the same properties as that one from which they came. In fact, each one will increase and divide in its turn; and, at the end of a certain time, the broth will contain millions and millions of bacteria identical with the first (Fig. 29). The broth, on the contrary, as the natural result,

has become much modified; as is the case with all inanimate substances when they are the scenes of chemical reaction.

"Here is an important phenomenon. Let us suppose, for the sake of argument, that the bacteria at the beginning of our observations was composed of five substances, essential to the production of the phenomena which have struck us; we can safely affirm that these five substances exist in the thousands and thousands of bacteria which have come from the first, and even that each of these five substances exists in exactly the same quantities in these thousands as in the first, as all were reproduced in the same manner, with one out of the number as a point of departure, if the broth be renewed. It is then certain that these five substances, instead of being destroyed, have multiplied themselves in the same manner; the result of the reactions having taken place between them and their environment."

Thus living matter is distinguished from that which is inanimate by the fact that the incessant chemical actions of which it is the scene, nourish it and cause it to multiply, whereas the inanimate matter is consumed and destroyed by the chemical reactions through which it passes. Evidently *that* is the real difference between the living and the inert matter. Can the inanimate matter of itself pass into the condition of living matter? The fact has never been observed. Can one suppose it possible? Apparently not; for as long as the inanimate matter is subject to physical forces only, and to chemical reactions only, it could but be consumed, destroyed, transformed, and would only become fresh inert matter, subject to the same law.

(*d*) *Growth and multiplication.* — The living plastic matter, is preserved and developed by assimilation. The cellular unity soon loses its state of repose; it becomes divided, or rather divides itself. As a drop of water about to fall increases in size, and losing its equilibrium,

a portion of it drops; thus the living cellule is divided into two parts, sometimes equal, sometimes unequal (Fig. 30).

If during this growth, the increase of size is noted, then the phenomenon resembles assimilation; but if the act of division is considered, then the fact can be referred, as Le Dantec wishes, to the purely physical order. If the circumstances and configuration are considered, which the

FIG. 30.—Cellular divisions of a fertile cell of pollen.

A. Mother-cell.
B. The filaments divide into V-like shapes.
C. The directing spheres are placed at the poles of the cell.
D. The protoplasm assumes a spindle-shape form.
E. The directing spheres divide.
F. The central fragments approach the poles.
G. The two new cells, each with separate walls.

new cellules take in the multicellular organism, then the phenomenon relates to evolution, of which we shall speak presently.

All cellular multiplication might be called an act of reproduction; it is in fact the only mode of reproduction in the lower organisms. But in the greater number of cases, amongst the multicellular creatures, this reproduction consists in this, that a well defined plasm, found in the body

of the parent, develops itself by passing through all the phases previously adopted by the parent. The formation of the mother-cell is an act of division, in which perhaps a physical force only intervenes; but its development, following a plan known beforehand, is a phenomenon that can only be considered vital.

(*e*) *The development of the individual.*—The most characteristic of the properties of the living organism, the most irreducible to physical laws, that which reveals the mysterious force inherent in life, is the evolution of the germ. This evolution consists in the faithful reproduction,

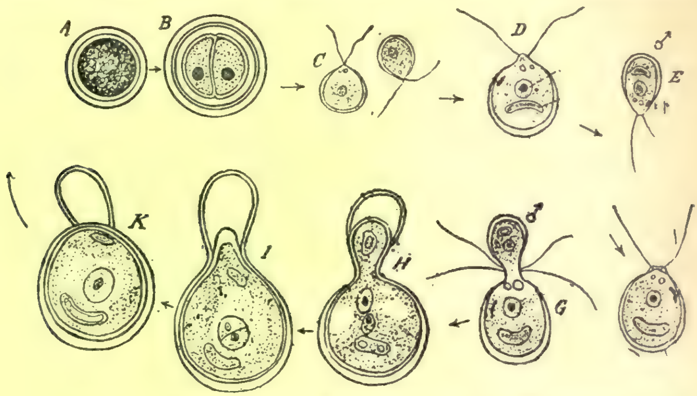


FIG. 31.—The evolutions of seaweed (Chlamydomonas Braunii).

during phases of a longer or shorter duration, more or less complicated, of the adult form of the parent.

It is also noticeable in the unicellular organisms. They are far from resembling each other, as the study of the Protozoa, Algæ, and mushrooms have shown. However, all celled-germs, however rudimentary they are at the beginning, reproduce the form of the parent. They do not hesitate—they make no mistake—they go straight to their goal. If the influence of their environment causes a deviation, it is of such a nature, that it carries the mark of an effort towards the end that was to be attained (Figs. 31 and 32).

The more complicated the organism, the more marvellous does the evolution appear. One single cellule carries in

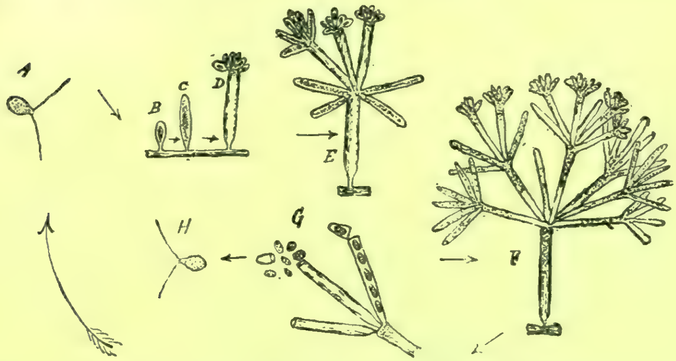


FIG. 32.—The evolutions of a tubular or a weed (Sciadium arbuscula).—A, the spore; B, E, F, the development of the plant; G, sporulation; H, new spore.

itself the power to become here a Fern, there an Oak, elsewhere a Star-fish or Medusa (Fig. 33), elsewhere again a Mammifer. The observer would be very clever who could detect in the germ the design of the development, as the future organism is not found in miniature in the germ. It is truly a creation. As the cellules divide, they occupy a foreordained place; assume a premeditated shape; and yield themselves up for the purpose of constituting foreordained organs. The result is always a similar form to that of the parent from which the germ was detached.[1]

Moreover the simplest cellular division is made with consummate art, always following the same laws with a repetition of phenomena in an unswerving order. A guiding intelligence hidden under the surface of the mass could not bring about the evolution with a more infallible certainty.

[1] "Ce n'est pas une rencontre fortuite de phénomènes physico-chimiques qui construit chaque être sur un plan et suivant un dessin *fixes et prévus d'avance*, et suscite l'admirable subordination et l'harmonieux concert des actes de la vie." Cl. Bernard, *Leçon sur les phénomènes de la vie*, p. 50.

Inanimate matter shows us nothing similar, not even in crystallisation. When a crystal is formed in the mother-liquid it is not a germ which has been developed. Molecules were slowly deposited in quiet water, their lines readjust themselves so as to be in keeping with their many-sidedness, but they simply place themselves mechanically,

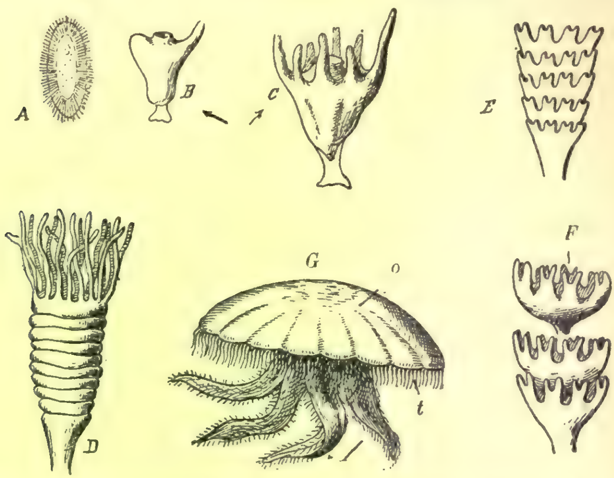


Fig. 33.—The development of a Medusa (Aurelia ~~aurita~~). aurilla

A. A free ciliary larva.

B, C, D, E. The development of the creature after being attached.

F. Detachment of Medusæ.

G. A Medusa; *b*, tentacles surrounding mouth; *t*, marginal tentacles; *o*, convex covering.

like the stone cubes that are piled up in pyramids, more or less regular.

The reason for the evolution of the germ is not found either in the chemical elements which compose it, nor in the physical forces by which its surroundings influence it. The germ commences its movements, and brings them to their proper conclusion by virtue of a power peculiar to it as a living organism. And if the power of evolution belongs naturally to all living matter alike, it shows itself

in an infinity of diverse species; it has in fact as many designs as species.

In following a germ through the phases of its development it would no doubt be possible to note all the physical actions which come into play, and all the chemical reactions which are brought to bear on it; there is no modification of the living being but arises from physical or chemical causes; but no phenomenon arises entirely from them, because the "raison d'être" of each physiological fact which has its place in the general plan, cannot be looked for in forces which are in themselves indifferent. Above all, the chain of facts cannot be referred to the aforesaid forces, as it remains the same under very various conditions; it realizes an *ideal* by the agency of blind forces.

We will recapitulate what has gone before. The difference between inert matter and living matter is profound. Although formed of similar elemental matter and submitting to the same external forces, they show certain properties which clearly distinguish them. Unstable chemical conditions, structure, assimilation, the development of germs following a pre-determined place—these are the characteristic traits of the living substance. The inanimate mass can only acquire them by assimilating itself with a living substance which is pre-existent. Can the inert matter acquire these traits of itself? The distance is too great to be traversed; with whatever care nature has been observed, whatever close attention has been given to the subject, no one has seen the space bridged over.

In the present state of things, by appealing to the unknown, critics might contest our right to conclude definitely that the transition is impossible. For our argument is not of such mathematical precision as to exclude any hypothesis. But if we confront the hypothesis which denies the possibility of the transition with that which affirms it, it is evidently the first which has the clearest right to exist, because it can bring forward the facts of observation and

experience; it can maintain the difficulty of bridging over a gulf of great depth, and which has never been known to be crossed.

We should perhaps carry our conclusions still further, if the ancient philosophers had not admitted the possibility of a passage from lifeless to living matter. Aristotle and all the ancients with him believed in the fact of spontaneous generation. St Thomas Aquinas, with the doctors of the Middle Ages, also believed in it. To explain an undisputed fact, although erroneous, a theory is necessary. The theory in the Middle Ages consisted in saying that God had given power to inert matter to organise itself in concert with certain terrestrial forces, such as heat, humidity, and not clearly defined astral influences (St Th. Aqu. Sum. Theol., 1 pars, q. 71).

It hardly becomes us to trench on this point of possibility, concerning which so many powerful intellects have felt hesitation. We will only speak of facts. Experience and reason both combine in teaching us that no spontaneous generation has ever taken place; that inanimate matter does not become a living organism except under the influence of pre-existing life.

§ 4. *The Primitive Origin of Life.*

In that which precedes we have endeavoured to solve the problem of the origin of life by passing the facts in review. From these we demonstrate—(1) that life began on this earth; (2) it could not have begun by spontaneous generation; (3) that it began by the Divine Act of Creation.

1. It is certain that *life began on the earth.*—To prove this, it is not necessary to have recourse to metaphysics, and to say that an eternal series of phenomena concerning life would form a concrete number which the mind cannot conceive. Geology is sufficiently advanced to teach us that

life has had a beginning, and even the period when it commenced.

There was a time when the entire crust of the earth's surface was in a state of igneous fusion under the enormous pressure of three hundred atmospheres; in fact, those parts of every country in the world which are under the sedimentary rocks are formed of rocks that are alike, and whose structure shows a former state of fusion at a temperature undoubtedly higher than the burning lava of volcanoes. Now, on this inflamed surface, in this furnace-like atmosphere, no life would be possible, no germ could have resisted it. It is impossible to conceive of any adaptation which would have enabled the primitive organisms to live in the midst of this excessive heat, for there are limits to adaptation. Above 600° centigrade, water would be resolved into its elements; the molecules of an organised body could not have remained united; how is it possible to conceive of a living being, when the state of the elements was such as to prevent it being maintained as whole?

Moreover, if we consider with Laplace and de Faye, that the earth appeared by way of physical evolution, from a solar nebulosity, was not life incompatible with the primitive condition of the dispersion of atoms?

Certain authors have pretended that germs may have fallen on the earth's surface, by dust escaping into space, during the passage of comets, and shooting stars. Even if we admit as possible, that the earth during its course through space, collects cosmic dust too fine to attract our notice—even if we admit (which is not probable) that living germs are found amongst this stellar dust, as they are found in our atmosphere—what should we conclude from this? The question is not answered but merely removed to a greater distance—to an earlier period. How did life begin on these heavenly bodies which have enriched us with their germs, seeing that these stars have undergone the same phases as the earth itself?

Therefore whether on the earth, or on some unknown star, it is certain that life has commenced. But in what way?

2. *Life did not begin by spontaneous generation.*—The materialistic school upholds the contrary thesis with an ardour easy to understand. We will state their arguments, which are borrowed from Hæckel, confronting them with the arguments that prove our proposition. The reader will easily see towards which side earnest science and solid reason incline. Hæckel states clearly the following alternatives. "We must choose between the two possibilities; natural evolution or supernatural creation. If we reject monistic evolution, nothing remains but the irrational hypothesis of a miracle, of supernatural creation." Which is the same as saying, "Life began with spontaneous generation, or by Divine Creation; the second hypothesis we reject as irrational and opposed to science—therefore life began with spontaneous generation." Hæckel considers all systems as opposed to science, in which nature, with its atoms and vital action, cannot be explained by itself, nor is sufficient of itself alone, either with regard to primitive creation, or to its order and organization. Such a gratuitous postulate takes for granted that those problems with which philosophy is engaged, are already solved.

The arguments being thus constructed, Hæckel recounts in what way the spontaneous formation of the first protoplasm took place. "The living bodies *must have* been formed chemically at the cost of inorganic compounds; thus that complex substance *must have* appeared which we call protoplasm, which contains carbon and nitrogen, and which is the material scene of all vital activities. The first Monads made their appearance at the beginning of the Laurentian period; they come from inorganic compounds, and are simple combinations of carbon, carbonic acid, hydrogen and nitrogen."[1] Facts so vague and reasons so unsound,

[1] Cité dans Vigouroux, *Les Livres Saints*, t. iii., 3rd ed., p. 179.

clearly prove that Hæckel admits of Spontaneous Generation because he feels it a philosophical necessity to avoid God.

The following propositions seem to us impossible to attack. The laws of nature are constant—as in time so in space. Now in our days, it is a certain law that life is not produced spontaneously. Neither at the beginning was life produced from lifeless matter by the power of physical forces alone.

The immutability of the natural laws through the centuries, is the foundation of all scientific induction. If the natural forces changed their nature, it would be impossible to deduce past facts from our knowledge of things present. Physical laws being unchangeable, it follows that what happens to-day, is that which took place formerly. Doubtless, according to the just remark of M. de Lapparent, there are differences of *intensity* in physical actions; but no difference in their nature. This principle forms the invariable basis of all science, and especially of geology.

Is it a simple difference of degree only, to produce life spontaneously, or not so to produce it? If inanimate matter could create life formerly by itself, and is incapable of doing it to-day, has it not changed its nature? To this the objection cannot be made that the same physical conditions do not hold sway now; atomic elements, humidity, heat, electricity are all in a state of activity; if matter no longer produces life then it has changed its nature.

These considerations press the partisans of spontaneous generation so closely, that in order to preserve the idea of the spontaneity of the primitive origin they frankly assert that life must be produced in the same fashion at the present time. But we have demonstrated very clearly that no life is produced really by spontaneous generation. Which is the reason that we reject the spontaneity of the first beginning.

3. *Life began by a Divine Act of Creation.*—It is hardly necessary to say that this is the logical conclusion of all our

study. We must have recourse to a power superior to matter or physical forces; possessing life in a pre-eminent degree; and which decrees its manifestation by an act of His Will.

Hæckel has greatly erred in thinking that to recognise the intervention of God in nature is antiscientific.[1] True science is not necessarily antagonistic to God. It starts from well-founded facts, or evident principles, and then moves triumphant to the conquest of the conclusions which logically follow. Now in starting from a concrete fact, such as the origin of life; or an established principle, such as that of causality, our whole science has for its logical result a personal Sovereign Being; the Creator of the world, who does not abandon His work after having created it. Science is not an indefinite mass of observations and experiments; its essence is to trace out causes. Hæckel knows this well, and seeks also to discover the supreme cause; but for him this is nothing more than mechanical movement.

This mechanical movement does not explain the world, nor explain life for us; it requires to be explained itself by a prime mover. This Prime Mover, who is sufficient of Himself, who impresses Himself on all movement, is the final Object to which all the avenues of science lead.

The materialists, we observe, seem to have more at stake than we have in these discussions. In fact, even if life had begun spontaneously, we should still have recognised God, and science would still have demonstrated Him as the First and Supreme cause. Whereas in order to overthrow the monistic belief of Hæckel, it is sufficient to show that some event had occurred which could only be explained by the intervention of God.

The ancients feared to see God face to face. Even

[1] "Puisqu'il est acquis que le point de départ de tout être vivant est un *germe*, il s'ensuit que l'origine de la vie sur le globe terrestre implique l'existence d'une *cause première*." (E. Ferrière, *La vie et l'âme*, p. 561, Paris, 1889.)

amongst the Hebrews it was said: "I have seen God. I shall die." In the same way the spirit of the age, alienated from God by the secularisation of the sciences, is affrighted and troubled when His image is apparent as the final conclusion of all man's reasonings. As the correctness of a path is doubted when it leads to a precipice, so the warped intellects of our time doubt the correctness of their logic when it leads to God.

We, on the contrary, adore the Majesty which is revealed in our sciences and to our reason, at the same time as to our Faith. We take courage when we feel that the legitimate conclusions of real science strengthen the decisions of our ancient Faith.

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CHAPTER III

ORIGIN OF SPECIES

§ 1. *A General Statement of the Question.*

In studying the laws of life, and the conditions by which it was produced, we arrive at this conclusion. At the beginning, when the earth, having become cooled, and surrounded by the oceans, was in a condition to support and nourish animated beings, God created life by an act of almighty power. As nature alone is incapable of imparting the vital movement to the mineral matter, the intervention of a superior power became necessary.

But life clothes itself in thousands of forms. From the first it wás divided into two great kingdoms, the vegetable and the animal. Plants present various types, in which great differences may be perceived: from the unicellular alga to the oak, vegetable life takes all degrees of complexity. With regard to animals we find the same variety and the same ascending scale; nothing can be more simple than one of the infusoria, no machine has been put together more cunningly than the organism of a mammifer. Numberless species are ranged in the two kingdoms. Who produced them? Did God Himself fashion directly each of these forms? Or was the first living protoplasm endowed with power to create of itself, so well-ordered an assembly, under the influence of physical energy only? This is the question which will be discussed in these pages.

Two opposite systems are brought forward, both claiming to solve the difficulty. The creationists' theory and that of evolution. The fixity of species is held by those advocating

the first; they consider that types are not transmutable, and teach that God fashioned them directly, one by one, by as many creative acts. *Evolution*, or the theory of a common descent, starts from the organic plasticity of the species, denies the fixity of the same, and looks upon them as so many distinct branches coming from a common trunk.

The partisans of evolution can be divided into two principal classes. The one thinks that the formation of species was the result of a special law laid down by the Creator for the development of life. Thus their theory is connected with that of the creationists. The other class thinks that the living species do not point to the existence of any biological plan conceived by the Creator, but that they are the inevitable result of a purely mechanical law to which life was compelled to conform.

No question, perhaps, has been more keenly debated during the second half of the nineteenth century, not merely amongst the learned, but in all classes. This is no doubt because the gravest religious and moral interests seem involved in it. The freethinkers took advantage of it to oppose Faith and the spiritual view; by attributing to nature alone the creation of its most beautiful works, and in proclaiming the animal origin of man, they arrived at a negation of God and of the human soul. Catholics, justly alarmed at these conclusions, vigorously opposed those theories which seemed logically to lead to them; and there was a time when the terms, materialists and evolutionists on the one side, and catholics and creationists on the other, seemed indissolubly united.

Henceforth efforts were made to return to moderation; instead of taking refuge in extremes, those interested endeavoured to hold more just views of experimental facts and of philosophical principles, when arriving at conclusions. As agitated feelings were calmed, and views became more clearly defined, it was found that a middle opinion might form a common meeting ground.

Seeing the order which reigns in nature, and of which chance cannot be the author, we look upon it as certain that God ordained the formation of species. But that which seems to us a matter for dispute is this; in what way did He create them; did He Himself intervene *directly*, as many times as there are distinct special forms, enumerated by naturalists; or was He the First Cause, by imposing a law of evolution, or creation by common descent? This is the ground, according to our idea, on which the question rests.

We shall conscientiously state the facts, leaving to the reader the task of taking a side; only observing that in this, as in all controversy, the case must not be judged, before the necessary study has been given to it. Moreover, whatever the solution arrived at, it can only be considered a matter of opinion; for if the evolutionists do not lack argument, the supporters of the theory of direct creation cannot justly be accused of ignorance.

After an historical summary of the question, we shall study the *facts* brought forward by evolutionists; the *theories* to which they have recourse in explaining the common descent; what there is reprehensible in *extreme* transformism; what we are to understand by the expression *modified* or *spiritualised evolution*; and finally the *arguments* which the partisans of "Creation" oppose to any kind of evolution. Man will be left out of this discussion, as he will form the subject of a subsequent study.

§ 2. *The Historical Summary.*[1]

There are questions as old as the world, and which will last as long as it has an existence, viz., those problems which concern its destiny; the existence of God; Creation;

[1] For the history of the views of the origin of species, see Ed. Perrier. *La philosophie zoologique avant Darwin*, Paris, 1896, 3rd edition; de Quatrefage's *Darwin et ses précurseurs français*, 2nd edition; du même, *Les émules de Darwin*, Paris, 1894.

the origin and end of Man; the spirituality and immortality of the soul. The questions of secondary importance, and which are farther from the heart of humanity, have in some sort a marked date of birth, and often also of death. The question of the origin of living species is certainly of this number; it was only clearly stated at the beginning of this century in 1809, by the French naturalist Lamarck.

Nevertheless, allusions to the subject have been sought for amongst the ancients. Plato and Aristotle, with their ideas of prototypes, would have been partisans of the fixity and autonomy of species. Aristotle, struck by the order which reigns amongst the various species, would certainly not have considered it the result of blind forces. Darwin is therefore incorrect in quoting him as one of his precursors. But Thales of Miletus, Anaximander, and afterwards the atomists Leucippus and Democritus, believing on the contrary that creatures were formed spontaneously from mud by the action of the sun, inclined towards the extreme variability of form. These were followed by the poet Lucretius, who seems to have noted and described the struggle for existence and the theory of natural selection.[1]

The problem did not advance in the Middle Ages; it was reason and not science which made progress in the twelfth and thirteenth centuries. But as early as the sixteenth century Bacon shows himself convinced of the

[1] "In the first centuries, many races of animals necessarily disappeared, without reproducing and perpetuating themselves. All those which we see around us, only protected themselves from destruction, either by cunning, power, or agility, which qualities they possessed at birth. Many animals useful to us were only preserved by reason of the protection we accorded to them. The race of wild beasts, such as lions and others, are protected by their strength, the fox by its cunning, the stag by the rapidity of its flight. The faithful and vigilant dog; all the progenitors of beasts of burden; those flocks which produce wool and are horned, have been confided to the care of man. But why should we have protected the useless animals which had been denied the qualities necessary to enable them to lead an independent existence? Bound by the chains of fate, these creatures have served as prey to their stronger rivals, until nature has destroyed their species." (Lucretius, *De natura rerum*, book v. 800.)

variability of form, as he proposes that an institution should be founded, where the metamorphosis of organisms would have been attempted, and where the diversity and multiplication of species would have been studied.

The naturalists of the eighteenth century were evidently occupied with the origin of species. Many of them, such as Tournefort, Bonnet, de Maillet, and Robinet, believed in the real relationship of the species, and supposed them to have come from a common ancestor; but in order to account for it, they have had recourse to the most strange and fantastic hypotheses. Linnæus, after having declared that "there existed as many species as God had created at the beginning," afterwards concluded that God had only created genera, of which the species would be only the varieties. Buffon [1] at first adhered to the idea of the common origin of species, but finally, whilst recognising the struggle for existence, and natural selection, he became uncertain, and declared that the species was neither immovable nor transmutable. Kant, Diderot,[2] Maupertuis,[3]

[1] Here is a passage from Buffon plainly showing that he inclines to the common descent. "Que l'on considère, comme l'a remarqué M. Daubenton, que le pied d'un chavel, en apparence si différent de la main de l'homme, est cependant composé des mêmes os, et l'on jugera si cette ressemblance cachée n'est pas plus merveilleuse que les différences apparentes, si cette conformité constante et ce dessein suivi de l'homme aux quadrupèdes, des quadrupèdes aux cétacés, etc., . . . dans lesquels les parties essentielles, comme le cœur, les intestins, l'epine du dos, les sens, etc. . . . se trouvent toujours, ne semblent pas indiquer qu'en *créant les animaux l'Être suprême n'a voulu employer qu'une seule idée et la varier en même temps de toutes les manières possibles*, afin que l'homme pùt admirer également et la magnificence de l'exécution et la simplicité du dessein." Cité dans Perrier, *Philosophie zoologique*, p. 60, Paris, 1896. Dans la suite du même passage, Buffon arrive à supposer . . . "*même que tous les animaux ne sont venus que d'un seul animal, qui, dans la succession des temps, a produit, en se perfectionnant et en dégénérant, toutes les races des autres animaux.*" *Ibid.*, p. 61.

[2] "De même que, dans les règnes animal et végétal, un individu commence pour ainsi dire, s'accroît, dure, dépérit et passe, n'en serait-il pas de même des espèces entières?" Diderot. Cité par E. Perrier, p. 53.

[3] Ne pourrait-on pas expliquer comment de deux seuls individus la multiplication des espèces dissemblables aurait pu s'ensuivre? Elles n'auraient

Oken and Goethe are supposed to have entertained some idea of evolution. But Darwin's ancestor, Erasmus Darwin, is the one who most definitely explained the formation of species. According to his belief, the species were modified by, and under, the influence of necessities from within, rather than guided by conditions from without, consequently his ideas more closely approached those of Lamarck than those of his grandson.

Lamarck (1744-1829) was Cuvier's colleague at the Natural History Museum. His ideas are contained in his two chief works : *Philosophie zoologique* (1809) and *Histoire des animaux sans vertèbres* (1810). He was led to think of evolution by the difficulty he found in classifying species and in distinguishing their natural limits.[1] This mingling of approximate forms led him to believe that there were as many varieties, which were the issues of the common ancestral forms. The first animals placed in different environments experienced differing necessities, and in order to satisfy these necessities existing organs were modified, whilst useless ones became atrophied and gradually disappeared entirely; heredity fixed in their descendants those variations which were the result of necessity.[2] Lamarck applied

dû leur première origine qu'à quelques productions fortuites, dans lesquelles les parties élémentaires n'auraient pas retenu l'ordre qu'elles tenaient dans les animaux pères et mères ; chaque degré d'erreur aurait fait une nouvelle espèce ; et à force d'écarts répétés serait venue la diversité infinie des animaux que nous voyons aujourd'hui, diversité qui s'accroîtra avec le temps, mais à laquelle peut-être la suite des temps n'apporte que des accroissements imperceptibles." Maupertuis. Cité dans Ed. Perrier, p. 53.

[1] M. Duval, *Le transformiste français Lamarck*. *Revue scientifique*, 5 et 12 Oct. 1889.

[2] These are the two fundamental laws enunciated by Lamarck :

1. Dans tout animal qui n'a point dépassé le terme de ses développements, l'emploi plus fréquent et plus soutenu d'un organe quelconque fortifie peu à peu cet organe, le développe, l'agrandit et lui donne une puissance proportionnée à la durée de cet emploi ; tandis que le défaut constant d'usage de tel organe l'affaiblit insensiblement, le détériore, diminue progressivement ses facultés et finit par le faire disparaître.

2. Tout ce que la nature a fait acquérir ou perdre aux individus par l'influence des circonstances où leur race se trouve depuis longtemps exposée,

this principle to the long neck of the giraffe, the horns of ruminants, the hoofs of pachyderms, etc.

Cuvier strongly opposed Lamarck's views. But whilst upholding the fixity of species, Cuvier fell into a grave error: in order to account for the changes which have occurred in the fauna and flora during the geological periods, he supposes that certain revolutions of the globe periodically caused the complete destruction of all species, and that God at intervals renewed all creation.

Etienne Geoffroy Saint-Hilaire (1772-1844) inclined rather to Lamarck's views. It was to the environment, especially the respiratory, that he attributed the greatest influence on species. Whilst Lamarck teaches the transformation of adults, Geoffroy Saint-Hilaire believes that only embryos suffer change: in his eyes, species represent so many monstrosities [1] produced suddenly and transmitted by heredity. He also sees in evolution the execution of a plan "chaque chose arrive à un moment préfixé," and willed by God.[2]

et, par conséquent, par l'influence de l'emploi prédominant de tel organe ou par celle d'un défaut constant d'usage de telle partie, elle le conserve par la génération aux nouveaux individus qui en proviennent, pourvu que les changements acquis soient communs aux deux sexes ou à ceux qui ont produit ces nouveaux individus. (*Cf.* Perrier, p. 76.)

In the eyes of Lamarck, animals and plants form a ladder which represent "l'ordre qui appartient à la nature et qui résulte, ainsi que les objets que cet ordre fait exister, des moyens qu'elle a reçus de l'Auteur suprême de toute chose. Elle n'est elle-même que l'ordre général et immuable que ce sublime Auteur a créé dans tout, et que l'ensemble des lois générales et particulières auxquelles cet ordre est assujetti. Par ces moyens dont elle continue sans altération l'usage, elle a donné et donne perpétuellement l'existence à ses productions; elle les varie et les renouvelle sans cesse et conserve ainsi partout l'ordre entier qui en est l'effet." (*Philosophie zoologique*, t. i. p. 113.)

[1] Darwin says: "By a monstrosity I presume is meant some considerable deviation of structure, generally injurious, or not useful to the species." (Translator's Note, *Origin of Species*, p. 31, 6th edition.)

[2] "La nature n'a formé tous les êtres vivants que sur un plan unique, essentiellement le même dans son principe, mais qu'elle a varié de mille manières dans toutes ses parties accessoires." (Geoffroy Saint-Hilaire, *Mémoire sur les rapports naturels des Makis.*)

"Le monde ambiant est tout-puissant pour une altération des corps

Evolution had already made considerable progress amongst naturalists and philosophers when in 1859 Charles Darwin's book appeared.

Darwin (1812-1882), even in the eyes of his adversaries, was an acute observer, an honest, upright man, no sectarian, but sometimes forced forward by his disciples beyond the point to which he would himself have gone. In 1859, learning that Russell Wallace[1] was preparing a book for publication containing ideas similar to his own, he hastened to draw up and bring out his first edition of the *Origin of Species*.[2]

The entire work is based on a few simple propositions: all living creatures are the descendants of three or four primitive types created by God; in the inevitable struggle for existence the weakest perish, the fittest survive: this survival of the fittest produces species of which the characteristic variations are accentuated by time; those persistent variations are fixed by heredity, and are preserved from a return to the primitive type by the isolation caused by cataclysms and migrations.

Darwin encountered serious opposition from de Quatrefages, Blanchard, Faivre, Hébert, etc., but a large class

organisés. . . . Les modifications insensibles d'un siècle finissent par s'ajouter et se réunissent en une somme quelconque ; d'où il arrive que la respiration devient d'une exécution difficile et finalement impossible, quant à de certains systèmes d'organes ; elle nécessite alors et se crée à elle-même un autre arrangement, perfectionnant ou altérant les cellules pulmonaires dans lesquelles elle opère, modifications heureuses ou funestes, qui se propagent ou qui influent sur tout le reste de l'organisation animale. Car si ces modifications amènent des effets nuisibles, les animaux qui les éprouvent cessent d'exister, pour être remplacés par d'autres, avec les formes un peu changées, changées á la convenance des nouvelles circonstances." (*Influence du monde ambiant sur les formes animales.*)

[1] Wallace's book is called *Natural Selection* (translated into French by Candolle, Paris, 1872). The work is composed of a series of articles or essays dealing with the question of the origin of species. The last essay is on Man ; it is there he shows that the human organism cannot be considered as the outcome of natural selection.

[2] Traduction Barbier, faite sur l'édition anglaise définitive, Paris, Schleicker, 1896.

of young naturalists ranged themselves round him and proclaimed him their master. Wallace, Huxley, Spencer, Hæckel, Büchner, Vogt, etc. . . . declared themselves his disciples. But with these the question no longer rested on the ground of natural history alone, but had decidedly a philosophical import; the main point was no longer the evolution of species, but in addition to this, the spontaneous generation of life, the origin of the entire animal nature of man; a universal monism, which includes in a comprehensive synthesis the entire universe, "from the fall of a stone to the consciousness of man," and to the formation of societies; and explaining all by the mechanical movement of atoms only.[1]

Whilst philosophy was taking such daring and strange paths, the natural sciences were making important progress. Following Darwin's lead, and to confirm his theories, the learned investigated nature even to its most secret recesses. Darwinism benefited by the innumerable discoveries called forth by him: *by* him the facts are shown to be connected and explicable; *without* him facts are simply separate inharmonious statements, with no meaning. For this reason the need of a synthesis, natural to the human mind, gained

[1] Hæckel, a professor at Jena, is the most ardent propagator of these monistic ideas. At one time he affirmed that all nature was mechanical; at another he maintained that all was animated and living: the chief point with him was that all creatures are governed by the same physico-chemical laws.

"Gràce à la théorie de la descendance, on est pour la première fois en état de fonder la doctrine de l'unité de la nature, assez bien pour que l'intelligence de tous puisse expliquer par des causes mécaniques les phénomènes compliqués du monde organique, aussi facilement qu'un acte physique quelconque, par exemple, que les tremblements de terre, la direction du vent ou les courants marins. Nous arrivons ainsi à la conviction extrêmement importante que tous les corps connus de la nature sont également 'animés,' et que l'opposition jadis établie entre le monde des corps vivants et celui des corps morts n'existe pas. Qu'une pierre lancée dans l'espace libre tombe sur le sol d'après des lois déterminées; que, dans une solution saline, un cristal se forme; ces phénomèmes appartiennent tout aussi bien à la vie mécanique que la croissance ou la floraison des plantes, que la multiplication ou l'activité consciente des animaux, que la sensibilité ou l'entendement de l'homme." (Hæckel, *Histoire de la création naturelle*, p. 17, traduction Letourneau, 3rd edit. Paris, 1884.)

the greater number of the then living naturalists to evolution. But we must not forget that a hypothesis, simply because it is probable and explicable does not cease to be a hypothesis.

§ 3. *The Facts in favour of Evolution.*

It will now be shown how the interpretation of certain facts has led men of acknowledged sincerity to embrace the principles of evolution. Too often holders of the creationist view have stated that their opponents were at variance with common sense, and guided by irreligion. In this paragraph we shall confine ourselves strictly to the study of natural history ; reserving to a future time the question, what is to be thought of the philosophical impulse given to the idea of transformation.

1*st Fact. The variability of organic forms.*[1]—The plasticity of living creatures has long been known, it was this fact which struck Francis Bacon so forcibly and inspired him with the idea of opening an institution where the work of forming new species was to be carried on.

Organic variations seem chiefly to be produced under the influence of environment. Thus a dog, taken to the Polar regions, becomes covered with a warm coat of thick fur ; at the equator, on the contrary, he loses his fur. The cattle from Sologne removed to the Loire valleys increased in size and in value in two or three generations. In the cold countries of America pigs acquire a wool-like fleece. Man himself from a change of climate undergoes variations of complexion, size, and bony frame.[2]

[1] In order to learn many facts concerning the variations of organic forms, the following books may be consulted. Darwin's *Origin of Species* and *The Variation of Animals and Plants under Domestication.*—Yves Delage, *La structure du protoplasme et l'hérédité.*—*L'Année biologique de* 1895.—Faivre, *La variabilité des espèces et ses limites.*—Perrier, *Cours de Zoologie.*

[2] The formation of the Yankee race is a case in point. It is known that the Yankee is an Englishman modified by his adaptation to the climate and his surroundings in North America. The face has a paler tint, the hair is darker, the bones of the legs and arms are longer, the head smaller, and the neck more slender.

The facts of mimicry, so thoroughly studied by Russell Wallace,[1] testify to this facility of adaptation. These

FIG. 34.—Butterfly from the Malay Archipelago. When it is at rest on a branch it takes the appearance of a leaf with such exactness that it is easily mistaken for it.

powers of mimicry belong to certain species which are able to clothe themselves in the dress or appearance of

[1] Wallace, *Natural Selection*, pp. 45 to 130. "The inhabitants of a desert are generally of a fawn colour, which renders them almost invisible on the sand and amongst the stones: the best examples are the lion, antelope, and camel (p. 49). The Polar bear is the only one of its species which is white, and it always lives amongst the snow and ice; the blue fox (*isatis*), the ermine, and the hare of the Alps are only white in winter, because in summer white would be more conspicuous than any other colour, and would therefore

animals who are feared or disdained by the carnivorous kinds.[1]

FIGS. 35, 36.—On the left a Lepidoptera of the Hawk family; having the colour and appearance of a wasp. On the right a true wasp.

Insects and crustaceæ[2] present curious examples. The

become a danger rather than a protection. On the other hand, the American Polar hare, which inhabits regions of eternal snows, is white through the entire year (p. 50)."

This faculty of mimicry is especially developed amongst insects. *Cf.* Wallace, p. 52. "Some caterpillars are similar to the colours of the leaves on which they feed, others have the appearance of little pieces of wood; many are so strangely marked and wrinkled that when they are immovable it is difficult to discover that they are living creatures (Fig. 34). Murray has noticed that the larvæ of the peacock-moth, from its colouring, resembles the buds of the heather which it eats, and the spots of pink with which it is covered are like the flowers and buds of the same plant (p. 62). Amongst the Orthopteras, the family of *Phasmidæ*, or spectres, are all more or less imitative, or 'mockers,' as Darwin calls those which imitate others. Many of this kind are known by the name of 'walking-stick insects,' on account of their likeness to small branches. Some are a foot long, and as thick as a finger, their colour, form, wrinkles, the arrangement of the head, their feet, and antennæ all combine to cause their resemblance to a dead stick. They are suspended on the bushes in the forests, and have the quaint fashion of letting their feet hang irregularly, which adds to the difficulty of distinguishing them (p. 63)."

[1] "The insects mocked by others have always some special protection (Figs. 35 and 36), which causes them to be avoided as dangerous or unmanageable by the little insectivorous animals; some have a disagreeable taste, like the Heliconidæ (Figs. 37 and 38), others are covered with so hard a shell that it can neither be crushed nor digested; others are very alert, and armed with powerful mandibles, and possessing some secretion with an unpleasant smell. Some of the Eumorphidæ and Hispidæ, families of flat or hemispherical little collopteroids, give out a disagreeable secretion, and are copied by others belonging to a distinct order of Longicornes: our musked Callichrome is an example (p. 91)."

[2] M. Maisonneuve (*Création et évolution*, Comptes rendus du Congrès inter-

common frog also is green when amongst green grass, but becomes blacker when with dark objects: it thus escapes more easily from its enemies.

Animals also change their instincts as well as their anatomical characters.[1] What a difference of cleverness is found

FIGS. 37, 38.—On the left a South American moth, of which birds are very fond. On the right a daylight moth which secretes a nauseous odour, causing birds to avoid them.

in the various races of dogs, and yet they are of the same species. The enslaving ants have been led by the clever methods of M. Forel to use another kind for domestic purposes, in the place of those that they generally employ as slaves. The Pagurian or Hermit-crab, near the shore shelters itself in the shell of a mollusc, but at

national des catholiques de 1891) describes the changes of a little crustacean *Hippolyte varians,* at low tide on the wastes of Zostères. "Suivant la nature du milieu dans lequel elle vit, sa couleur varie de façon à se confondre avec les objets voisins ; verte, quand l'animal vit au milieu des algues vertes ; jaune, au milieu des laminaires ; rouge, lorsqu'il se tient parmi ces belles algues rouges désignées sous le nom de floridées ; enfin grise, quand il habite un fond vaseux."

[1] In his book named: *La personne humaine* (liv. ii. ch. iii.), M. l'Abbé Piat accumulates a number of facts to prove "que l'instinct se modifie comme tout ce qui vit, qu'il fait à chaque moment de petites trouvailles" (p. 211). Le loriot choisit des brins de ficelle ou un fil de laine pour suspendre son nid, comme un hamac, entre les branches des arbres. Évidemment, c'est là une matière de construction dont il n'a pu se servir au début et qu'il n'a employée dans la suite que parce qu'il y a vu des analogies avec des tiges d'herbes ou les poils d'animaux, qui faisaient, avant la civilisation, l'objet de sa convoitise. Les Cassiques, qu'on ne trouve qu'en Amérique, font de vastes nids avec des filaments végétaux ; mais, depuis qu'on a introduit le cheval dans le Nouveau Monde quelques-uns d'entre eux se sont mis à utiliser les crins de cet animal. (Piat, 221.)

a depth of about 1000 feet it lives without this protection.

Sometimes these changes are sudden, as those which are the result of the crossing of species or neighbouring races, and those resulting from deviation in the embryo; at other times they are slow and accumulate from heredity in the same line of descent. The animal in which a distinguishing characteristic shows itself, is only a variety, but when the characteristic is persistent and transmits itself, it then constitutes a race. Who can tell how many races have been formed by the care of the breeder; or produced amongst wild animals by a change of condition?

These are the principal facts brought forward in support of a common descent.

If the races developed by man, such as the 150 kinds of pigeons, or the 180 kinds of dogs, had been found in a wild state, so that their common origin was not known, one would have had no hesitation in classifying them as so many species and perhaps so many genera: may we not lawfully consider that the wild types which are sometimes classed as species by naturalists, may be looked upon as varieties proceeding from the same ancestors? Moreover, as in a few years races so divergent are seen to come from the same source, in the case of cattle or horses, is it not credible that time might still further increase these differences, so that the existing races might become distinct species, and the species be divided into genera? [1] Again, if these changes were in

[1] M. Yves Delage, when writing on the formation of species, begins with this proposition: "Les espèces proviennent de variations fixées (p. 813)." He next asks which variations are capable of becoming permanent. These are his three propositions:

1° La variation individuelle faible ne conduit jamais à la formation d'espèces nouvelles. Par variation faible, il entend celle qui constitue les petites particularités individuelles, celle qui distingue un Loup, un Lièvre, une Grenouille, d'un autre individu de ces espèces, lorsque les uns et les autres sont normalement conformés. C'est que, dit-il, la Sélection ne peut s'exercer que lorsque la variation présente de grands avantages.

2° La variation individuelle forte, celle qui appartient ou touche tout au

operation when the external conditions were steadfast, would they not have been greater and more rapid during the geological periods when the environment was much less stable?

It is possible, no doubt, to point to certain species which have rebelled against the law of variability; but far from invalidating the theory, these instances serve to show how certain species remained intact in the past, whilst others of the same kind underwent modifications.[1]

Certain persons who are not very familiar with the transformist theory imagine that it is concerned with the transformation of a given species into a neighbouring one, such as an ass into a horse, a dog into a wolf, or *vice versâ*. The species are not *transformed*, they are *formed* by divergences while departing from the common trunk, from which they have descended, and of which they retain the fundamental traits. Thus from the wild rock-pigeon have come 150 distinct races of pigeons; in proportion as these races diverge, they are distinguished more and more from each other without approaching nearer to other branches of a neighbouring species. The wolf does not come from the dog, nor the dog from the wolf; but the wolf and the dog would be two diverging branches from the same ancestral trunk.

2*nd Fact*. *The relationship of living forms.*—Ties of relationship seem to connect all living beings; those of the past

moins à la tératogénie, ne peut conduire que très exceptionnellement à la formation d'espèces nouvelles. Cette variation est en effet assez importante pour donner prise à la Sélection.

3° La formation des espèces est due à la fixation des variations générales. Par variations générales, Y. Delage entend celles qui atteignent à la fois l'ensemble des individus d'une race ou tout au moins un bon nombre d'individus, et qui porte le plus souvent sur plusieurs caractères sinon sur tous, à des degrés d'ailleurs très divers. Ces variations générales n'auraient pour facteurs que les conditions de vie, l'exercice et l'inaction. (*Cf.* Yves Delage, *La structure du protoplasme*, pp. 813-824.)

[1] An attentive study of the few species which remained unaltered during the geological periods shows that their steadfastness was the result of the constant character of the environment in which they lived. It is generally the abyssmal species amongst animals; and tropical cryptogams amongst plants.

as well as those of the present. These are the principal evidences.

The living substance of the protoplasm is the same in the vegetable as in the animal kingdom.[1] In the vegetable kingdom the living unity is enveloped in a cellulo~~id~~ sheath ; Se amongst animals the sheath is albuminous. The nutrition or sustentation of the individual acts in the same way in both kingdoms ; the operations of absorption of nutriment, digestion, assimilation, and respiration do not differ, except with regard to the organs in which they are accomplished. The manner of reproduction is the same in each.

It is easy to follow the varying degrees of complexity which is the bond of union between the more simple animals and those of a higher type. The Protozoa are composed of cellules of similar form, either isolated or united in colonies. The cellular colonies begin to differentiate at the cœlenterata. In the echinodermata internal organs can be clearly traced between the ectoderm and the entoderm. From that point the parts sometimes spread as rays round a centre, sometimes they place themselves in straight lines. In the latter case, the parts remain distinct as with the worms ; sometimes they become more or less compressed into a closer unity, as with the higher organisations. In his book, *Colonies animales,* M. Perrier has rightly emphasised the simplicity of the plan on which the different classes are formed.[2]

[1] This identity of the protoplasm is not absolute. If the chemical compositions were exactly identical, the living substance could not produce the dissimilar forms and operations which distinguish the divers species. Nevertheless these differences of composition are so slight, if capable of being discerned at all by analysis, that the right to speak of the unity or similarity of their substance must be admitted.

[2] It was especially this unity of plan which struck Geoffroy Saint-Hilaire : "Les formes diverses sous lesquelles (la nature) s'est plue à faire exister chaque espèce dérivent toutes les unes des autres ; il lui suffit de changer quelques-unes des proportions des organes pour les rendre propres à de nouvelles fonctions, pour en étendre ou restreindre les usages. . . . Toutes les différences les plus essentielles qui affectent chaque famille dépendant

Certain groups of species differ very slightly; in the graduated series it is not easy to find the lines of demarcation; the difficulty which Lamarck experienced in classifying them led him to the hypothesis of descent from a common origin.

Even in the species which seem widely separated, whether in the same class, or the same branch, the homologous parts are constructed in the same manner. Thus in the horse,

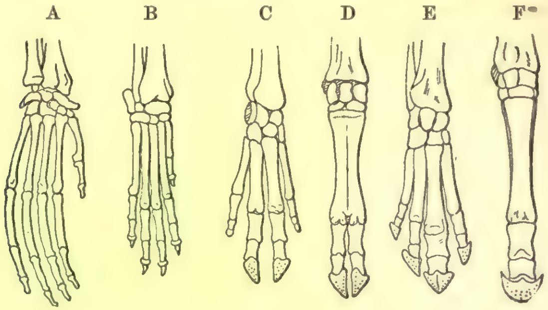


FIG. 39.—Bones of hand and fore-paw: A, orang; B, dog; C, pig; D, ox; E, tapir; F, horse.

the mole, the mouse, the porpoise, the whale, the fore-limb has the same bones, adjusted in the same manner (Fig. 39). The paws of mammifera, the wings of a bird, the members of a reptile, are identical in all essential parts.[1]

d'une même classe, viennent seulement d'un autre arrangement, d'une autre complication, d'une modification enfin de ces mêmes organes." (*Cf.* Perrier, *La philosophie zoologique*, p. 93.)

[1] "What can be more curious than that the hand of a man, formed for grasping, that of a mole for digging, the leg of the horse, the paddle of the porpoise, and the wing of the bat, should all be constructed on the same pattern, and should include similar bones, in the same relative positions? How curious it is, . . . that the hind-feet of the kangaroo, which are so well fitted for bounding over the open plains,—those of the climbing, leaf-eating koala, equally well fitted for grasping the branches of trees,—those of the ground-dwelling insect, or root-eating bandicoots,—and those of some other Australian marsupials,—should all be constructed on the same extraordinary type, namely, with the bones of the second and third digits extremely slender and enveloped within the same skin, so that they appear like a single toe furnished with two claws." (Darwin, *Origin of Species*, p. 358, 6th edition.)

The differences made apparent by anatomy cease, when traced back to the embryonic stage, where the formation of the different members is the same; similarly in remote geological periods, ancestors are found in whom the differences had not become evident.

Doubtless these facts point to a close morphological relationship between species of the same genera, less close between genera of the same class, and still less close between species on the outskirts of the animal kingdom.[1]

Are the bonds which unite living beings entirely ideal or intellectual,[2] or are they the result of a common descent? For the evolutionists the relationship is real.[3] All creatures descend from a common trunk, of which the sap has pro-

[1] Des intermédiares semblent venir à point relier des êtres qui paraissaient très éloignés les uns des autres par leur structure : le Lepidosiren relie les poissons aux reptiles, l'Archæopterix de Solenhofen relie les reptiles aux oiseaux, l'ornithorhynque relie les oiseaux aux mammifères. Voici comment M. Perrier signale l'Archæopterix : "On a trouvé dans les schistes de Solenhofen le squelette garni de plume d'un animal, dont le corps se prolongeait en une longue queue formée de 22 vertèbres ; ses membres antérieurs, quoique couverts de plumes, étaient terminés par trois doigts libres, munis d'ongles bien développés ; ses màchoires portaient des dents et il n'existait pas de bec ; le squelette était bien plus celui d'un lézard que celui d'un oiseau. Si l'on avait rencontré séparément le squelette et les plumes, on n'aurait pu soupconner un seul instant que ces débris pussent appartenir au même animal." (Perrier, *Anatomie et Physiologie animale*, Paris, 1881 (see Fig. 46).)

[2] M. L'Abbé Piat expresses himself in the following way on this subject: "Les types successifs sont-ils les descendants d'un même être, ou se ressemblent-ils comme les œuvres successives d'un même maître, ou les produits de plus en plus compliquês et de plus en plus parfaits d'un même atelier (abbé de Broglie)? C'est là une question sur laquelle les variations infinies des formes vivantes ne nous apprendront j'amais rien de rigoureux. La structure actuelle du monde s'explique aussi bien par la théorie opposée (que par la théorie transformiste)." (*La personne humaine*, pp. 178-180, Paris, Alcan, 1897.)

[3] "On the ordinary view of the independent creation of each being, we can only say that so it is ;—that it has pleased the Creator to construct all the animals and plants in each great class on a uniform plan ; but this is not a scientific explanation.

"The explanation is to a large extent simple, on the theory of the selection of successive slight modifications,—each modification being profitable in some way to the modified form, but often affecting by correlation other parts of the organisation. In changes of this nature, there will be little or no tendency

duced branches and various ramifications. They consider this affiliation a scientific explanation of species. The creationists' hypothesis appears to them on the contrary less scientific and less worthy of the Creator. This idea will be further discussed at a later period.

3rd Fact. The rudimentary organs.—Those organs are so called which are so slightly developed that they appear no longer able to perform any function. Thus in many reptiles the basilic or pectoral parts of the limbs only exist, and progression is accomplished without them. The eye at the top of the head (" unpaired eye," Dr Quain) is atrophied in the higher animals, but is still seen amongst some reptiles. In the male mammifera the mammæ are undeveloped and of no use.[1] Teeth which never pierce the gums are found in the upper jaw of a calf, and in the fœtus of a whale. The dog, pig and horse have digits, which are more or less atrophied and useless. The wings of ostriches are useless for flying.[2] The wing of *the apteryx* is simply a stump (Fig. 40).

to alter the original pattern, or to transpose the parts. . . . If we suppose that an early progenitor—the archetype as it may be called—of all mammals, birds, and reptiles, had its limbs constructed on the existing general pattern, for whatever purpose they served, we can at once perceive the plain signification of the homologous construction of the limbs throughout the class." (Darwin, *Origin of Species*, pp. 359, 360, 6th edition.)

[1] Darwin speaks in one place of an exception. *Origin of Species*, p. 373, 6th edition, Trs. note.

[2] The useless organs must be ranked with those which are atrophied ; the muscles of the ears of man are of no use ; the wings of a penguin are helpless for flight.

All rudimentary organs are not necessarily atrophied ; it may be a nascent organ. In this manner Darwin regards the filamentary limbs of the Lepidosiren, and the mammary glands of the Ornithorhynchus.

The atrophied condition of certain organs clearly appears to be the result of adaptation and environment. Thus the animals who live underground, or in dark caves, are blind and have only atrophied eyes. Wollaston has observed that a large proportion of the Coleoptera, in the Island of Madeira, cannot fly on account of imperfect wings. The beetles with wings are often carried by the wind into the sea, where they perish ; but those in which the wings were imperfect were saved from this peril, and transmitted to their numerous descendants this retrograde condition.

Certain organs are seen in the embryo which afterwards disappear in the

The transformists are able to find a reason for these organs in the theory of evolution : the creationist theory does not so well account for them.

According to the theory of the evolutionist these organs

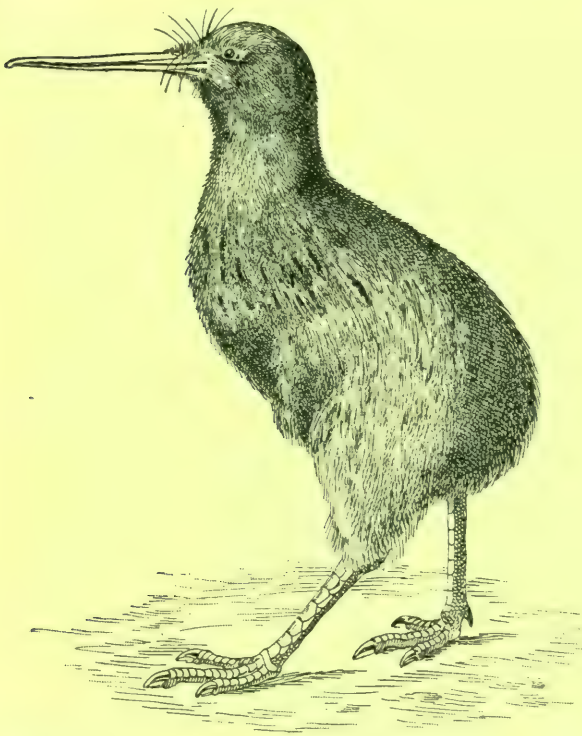


FIG. 40.—The apteryx, a bird incapable of flight ; with a rudimentary wing.

are like the signature of the ancestor running through all his descendants (Darwin). Just as in orthography letters which are not used in the pronunciation often reveal the

adult ; for instance the teeth in the upper jaw of the whale, and some ruminants. Generally the organ which appears rudimentary in the adult has in the embryo passed through a development relatively greater than the other parts.

origin of the word (*sang* from *sanguis, sens* from *sensus*), thus these rudimentary organs witness to a previous state through which a species has passed before attaining his present condition.[1] They show organic degradation in one species when compared with a neighbouring one. It is no doubt that disuse during many generations has produced atrophy, just as one now sees a muscle, or even a whole member dwindle when not sufficiently used.[2]

On the other hand no explanation which is embodied in the creationist's theory is at once simple and satisfying. There seems no apparent reason why God should have created portions of organs and stumps only of members, and parts which must remain useless: even "the symmetry of the general plan" does not explain these anomalies.[3]

4th Fact. Geographical distribution.[4]—The distribution of the fauna and flora on the surface of the globe

[1] "Rudimentary organs . . . are the record of a former state of things . . . The systematists, in placing organisms in their proper places in the natural system, have often found rudimentary parts as useful as, or even sometimes more useful than, parts of high physiological importance." (Darwin, *Origin of Species*, p. 377, 6th edition.)

[2] "It appears to me probable that disuse has been the main agent in rendering organs rudimentary. It would at first lead by slow steps to the more and more complete reduction of a part, until at last it became rudimentary. . . . Again, an organ, useful under certain conditions, might become injurious under others, as with the wings of beetles living on small and exposed islands; and in this case natural selection will have aided in reducing the organ, until it was rendered harmless and rudimentary." (Darwin, *Origin of Species*, p. 376, 6th edition.)

The same author further states that principles of the economy of growth would account for an organ which at first was useless, becoming rudimentary, and then disappearing altogether.

[3] "In works on natural history, rudimentary organs are generally said to have been created 'for the sake of symmetry' or in order 'to complete the scheme of nature.' But this is not an explanation, merely a restatement of the fact. Nor is it consistent with itself: thus the boa-constrictor has rudiments of hind limbs and of a pelvis, and if it be said that these bones have been retained 'to complete the scheme of nature,' why . . . have they not been retained by other snakes, which do not possess even a vestige of these same bones?" (Darwin, *Origin of Species*, p. 375, 6th edition.)

[4] *Cf.* Perier, *Le Transformisme.* (Darwin, *Origin of Species*, chap. xii.)

was the first fact that attracted Darwin's attention in his voyage round the world. In South America the fauna and flora come in due succession according to the degree of latitude traversed. In passing from one country to another near it, we find certain species replaced by others related to them. In islands and archipelagoes which surround vast continents, we find animal and vegetable productions appropriate to them. Still a close resemblance exists between the insular species and those on the nearest continent. The resemblance is closer between the animals which are found now actually existing, than between the fossil animals which preceded them on the same soil. The Old and the New Worlds possess very different fauna and flora although they have analogous biological conditions. In the same degree of latitude and in the same climate, animals differ very much in South America, Central Africa, and Australia; whereas the types which succeed each other in South America in different latitudes and varying climatic conditions, have a much closer connection. The mamm~~ifera~~ fauna of Australia, consisting chiefly of marsupials, are noticeably different from those of other continents. It is the finale of a series of species of the same group, which succeeded each other on the same continent, and by which it is linked to the fossil specimens which geologists discover in the other countries.

In the face of these facts, it would be an easy solution of the difficulty to say these things so placed prove that God wills it; that He has created the species where we now see them; that there were many centres of creation for the species which are found in countries separated by barriers which cannot be crossed.

But science, which searches out secondary, without denying primary causes, considering the present geographical arrangements as the results of physical perturbation, and closely allied to the ancient geographical position, concludes that the present distribution of the

fauna and flora is also the result of a previous condition of things.[1]

Are not the closely connected forms which succeed each other as we pass from one country to another only such varieties as have descended from a common parentage? Do not the insular species, which are separated from the neighbouring continents, owe the resemblances which connect them, to their common origin, and their differences to their new environment? How could the intimate connection between the continental species and the fossil remains which are found in the same place be explained except by the fact that the actual living species are descendants, more or less modified, of the fossil forms? It is not surprising that in the same latitudes, of lands separated by large seas, the species should be noticeably different; as the barrier which prevents their passage from one land to another has existed for some time. The forms which were isolated by the ancient cataclysms have had time to undergo very great changes. It is to this cause that the distinct fauna of Australia and the islands near must be attributed; these lands, separated from Asia since the Tertiary era, only possessed marsupials; from these species, whose remains are found in the soil, have descended the living specimens of to-day.

The distribution of the marine creatures leads us to the

[1] Thus when forms are found common to two countries it is more natural to admit that one spot gave them birth, which can be designated *their centre of creation*. We are surprised sometimes at meeting similar forms on continents which are separated by the Atlantic and Pacific Oceans. But it is well to remember that before the Glacial Period, the temperature of the Arctic regions was higher than it is to-day; those regions were then peopled by species which now are found only in lower latitudes. As land is known to be almost continuous round the pole, as it was probably in ancient times, one can understand that it was possible for species that inhabited these regions to betake themselves to both Worlds. This also explains the analogous condition of their present descendants. Their differences were no doubt caused by the conditions of their existence. The first dissimilarities became accentuated by time; and the resemblance of the species of the Tertiary era belonging to the United States and Europe, is closer than the now existing species.

same conclusion. The pelagian forms, or those belonging to the high seas, having a habitat which varies little, resemble the fossil remains. The littoral forms, or those inhabiting the sea-shores, living amongst surroundings which vary in time as much as in space, are very different, not only amongst themselves, but from the pelagic forms ; still in looking back through the geological periods, we find them united by intermediaries, to the ancient species which are still represented in the high seas. This leads us to speak of the palæontological argument.

5th Fact. Palæontological series.—The successive formations studied by geologists, are like the pages of a book, in which science can read the history of nature in general and the succession of living beings in particular. Many pages are missing in this book, either because a very small portion of the earth's surface has been explored, or because subsidence and degradation have destroyed many of these precious documents. Moreover, with the exception of molluscs, very few living creatures become fossilised: the terrestrial animals leave few traces. Therefore it is not a consecutive history; the record has large gaps in it, for which we must be prepared, in examining the leaves of the geological strata. Much of it therefore rests on a hypothesis formed on the interpretation of the preserved specimens, and filling up the spaces.[1]

If credence is to be given to the partisans of evolution, the characteristics which still remain are favourable to this theory; as new discoveries enrich the domains of palæon-

[1] "For my part, following out Lyell's metaphor, I look at the geological record as a history of the world imperfectly kept, and written in a changing dialect ; of this history we possess the last volume alone, relating only to two or three countries. Of this volume, only here and there a short chapter has been preserved ; and of each page, only here and there a few lines. Each word of the slowly-changing language, more or less different in the successive chapters, may represent the forms of life, which are entombed in our consecutive formations, and which falsely appear to have been abruptly introduced." (Darwin, *Origin of Species*, p. 271, 6th edition.)

tology, they only serve to confirm the hypothesis of descent.[1]

Animals did not all appear at the same epoch: the different species were formed successively during the course

FIG. 41.—Large Reptiles of the Secondary Era. Icthyosaurus, Plesiosaurus, Pterodactyle (flying).

of the geological periods; from the first origin of life to the creation of man fresh species have been recorded.

These appearances have not come suddenly, and at certain fixed times, as if, after a universal cataclysm, all nature

[1] Darwin did not disguise the difficulties which palæontologists raised against his theory, the absence of links showing the fine transitional forms between the now-existing species and those which formerly existed—the sudden manner in which several groups of species first appear in our European formations—the almost entire absence of formations rich in fossils beneath the Cambrian strata. He also shows that some of the most eminent palæontologists, namely, Cuvier, Agassiz, Barrande, Pictet, Falconer, Forbes, and the greatest geologists, as Lyell, Murchison, Sedgwick . . . "have unanimously, often vehemently, maintained the immutability of species." (Darwin, *Origin of Species*, p. 271, 6th edition.)

were recreated: the species are renewed by degrees, certain perish, others take their place. When a species is once

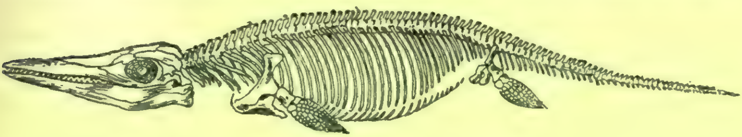


FIG. 42.—Skeleton of the Icthyosaurus.

extinct it does not reappear: it is this fact which enables geologists to characterise the beds of deposit by certain fossils.[1]

These species do not appear accidentally, but following always the same order, from the simple to the more complicated forms. The invertebrata lived before the vertebrata. Fishes appeared from the Silurian epoch amongst the vertebrata; the Batrachians next appeared on the first continents which emerged at the carboniferous periods; the reptiles began at the Secondary era (Figs. 41, 42, 43); birds and mammifera are first represented in the Secondary era, but they had not their full development until the Tertiary era.

FIG. 43.—Skeleton of the Pterodactyle.

If we take the existing species and seek for their

[1] "We can clearly understand why a species when once lost should never reappear, even if the very same conditions of life . . . should recur. . . . The two forms—the old and the new—would not be identically the same; for both would almost certainly inherit different characters from their distinct progenitors; and organisms already differing would vary in a different manner." (Darwin, *Origin of Species*, p. 274, 6th edition.)

ancestors in the past, we find that they have been preceded by types which differ in proportion to their distance from the present time. To give one instance only (Fig. 44), the horse now rests on one digit only, having two rudiments which are barely visible: the hipparion (Fig. 45), or the horse of the lower Pliocene, had these two rudiments very much developed; and in the Eocene horse, the two lateral digits were not only well developed, but another existed on

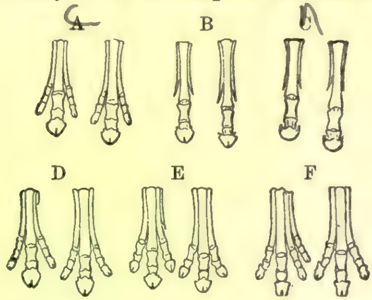


FIG. 44.—Evolution of the fore and hind leg of the equine genus: A, present horse; B, *Pliohippus*; C, *Protohippus* (hipparion); D, *Miohippus*; E, *Mesohippus*; F, *Orohippus.*

the hind limb: between these three types there existed intermediate varieties, according to the natural order of these times.

In fact, in the groups represented by numerous remains, the passage accomplished by imperceptible degrees, from one to the other, is very striking; these transitional forms are met with, in the group, either to unite the branches, or the higher genera; or in order to make known the history of species of the same genus. Thus the first Batrachians present many of the characteristics proper to fish: and the first birds, like the Archæopterix (Fig. 46) found at Solenhofen, have some of the properties of reptiles.[1] It is

[1] "The most common case, especially with respect to very distinct groups, such as fish and reptiles, seems to be that, supposing them to be distinguished at the present day by a score of characters, the ancient members are separated by a somewhat lesser number of characters, so that the two groups formerly made a somewhat nearer approach to each other than they now do." (Darwin, *Origin of Species*, p. 284, 6th edition.)

amongst the molluscs (where fossils abound) that the formation of the species can best be followed; amongst

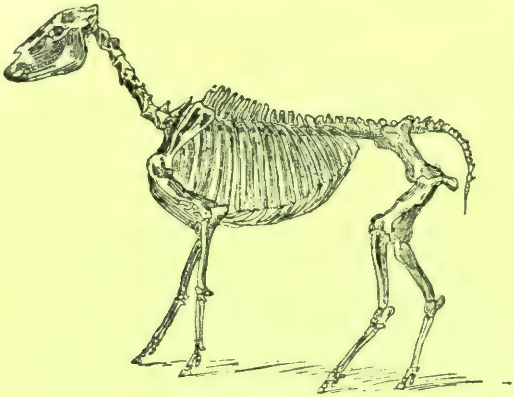


FIG. 45.—*Hipparion Gracile.*

the cephalopods, like the nautilus, the goniatites, and the ammonites; amongst the gasteropods, like the paludina, etc.

Whilst the creationist's theory supposes that God unceas-

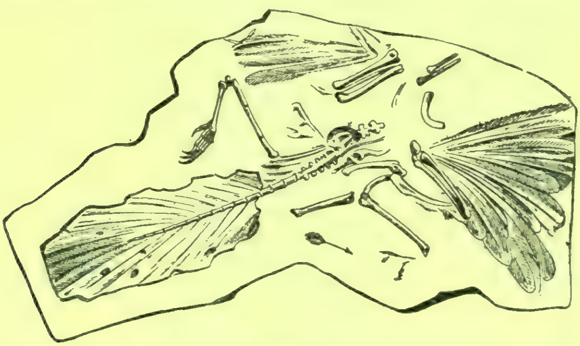


FIG. 46.—Archæopterix: remains found in the lithographic stone of Solenhofen; tail, vertebræ, reptilian members, bird's wings.

ingly renews and retouches His work in order to add traits as insignificant as are the specific differences, evolutionism

apparently gives a clear and scientific explanation of the successive palæontological remains. The primitive forms became modified and raised little by little by adapting themselves to their environment. As the conditions of life have much changed, so the living forms of each group have varied considerably. But as there have always been places where the conditions have remained unchanged, there have been necessarily creatures who have perpetuated themselves with no variation (the abysmal fauna).[1] Since from the Tertiary period conditions have remained practically the same, so the forms of species are found to be more stable. As the environments have never been suddenly, but always slowly modified, so life has never been entirely renewed at a single time but gradually. Since the differences which distinguish the animal classes come from a mode of arrangement of the parts fundamentally the same, it was possible for all the groups to be represented by their inferior types in the primitive soil.

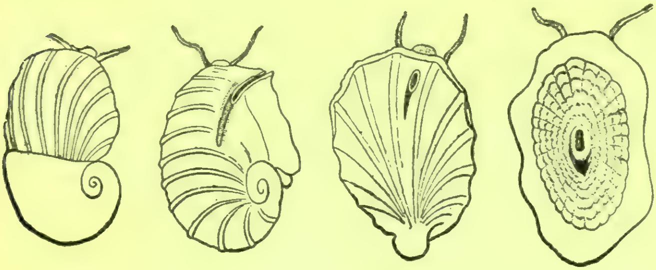
We will add that the successive developments of the vegetable kingdom furnish still clearer proofs in favour of evolution, as the order of appearance coincides exactly with the order of organic complexity; the cryptogams are alone in the primitive times, then the conifera and cycadaceæ; the monocotyledons and the dicotyledons appeared during the Secondary era, and only attained their height in the Tertiary era.

6th Fact. Embryology.[2]—Embryology, a science which

[1] For instance, the silurian lingula differ very little from the living species of that kind.

[2] See *L'Embryologie générale*, by Dr Roule, Paris, 1893, and Darwin's *Origin of Species*. This is how Darwin connects the palæontological with the embryological argument. "Agassiz and several other highly competent judges insist that ancient animals resemble to a certain extent the embryos of recent animals belonging to the same classes; and that the geological succession of extinct forms is nearly parallel with the embryological development of existing forms. This view accords admirably well with my theory. In a future chapter I shall attempt to show that the adult differs from its embryo, owing to variations having supervened during the life of individuals and inherited by

has made much progress lately, is the history of the individual development of the ovum to the adult form. The following are the principal facts which will help to enlighten us on the matter in question. All animals beginning from a primitive cellule resemble each other at the first. The early phases are common to all—segmentation, morula, planula, gastrula, etc. All animals proceed from the simple



A B C D

FIGS. 47-50.—Successive shapes of the shell *Fissurella reticulata.* A, the larval shell below, the adult above, with tentacles ; B, the second form of the adult shell, with a slit on the side, representing the condition which is permanent in *Emarginula* ; C, third form of the adult shell, with the closed orifice in the centre of the young shell, the permanent condition in *Rimula* ; D, the permanent condition of the adult shell of *Fissurella.*

to the complex form by a multitude of phases, during which they present analogous forms to those which inferior animals preserve all their lives (Figs. 47 to 50). Creatures derived from the same class, such as fish, present most striking resemblances during their development, up to the moment when they assume their own proper characteristics, and give evidence of divergences more or less marked. Others of the same division, but a different class, such as fish and mam-

their posterity at a corresponding age. This process, while it leaves the embryo almost unaltered, continually adds, in the course of successive generations, more and more difference to the adult. Thus the embryo comes to be left as a sort of picture, preserved by nature, of the former and less modified condition of the species." (Darwin's *Origin of Species*, p. 291, 6th edition.)

mifera, have a similar development up to fish types [1] (Figs. 51 to 54); at that point the fish take the special characteristics of their species; but the mammifera continue their progressive ascent, passing by conditions and forms which are permanent amongst the batrachians and transitory with themselves, and arrive finally at the characteristics of their class.

According to the transformists, creationism cannot give any reason for the curious similarity between the embryological and zoological series. For if it be correct that during development a creature passes from simple to complex, it could go at once to its goal, and not pass through interior forms, belonging to other species, and (as a whole) not conducive to its end and object.[2]

The theory of descent however offers a scientific explanation of it, according to the following law of Müller's: the

[1] All the vertebrate classes pass, in fact, through the same phases as the *Amphioxus*, which belongs to the lowest rank of fishes, or rather to the head of the protochords.

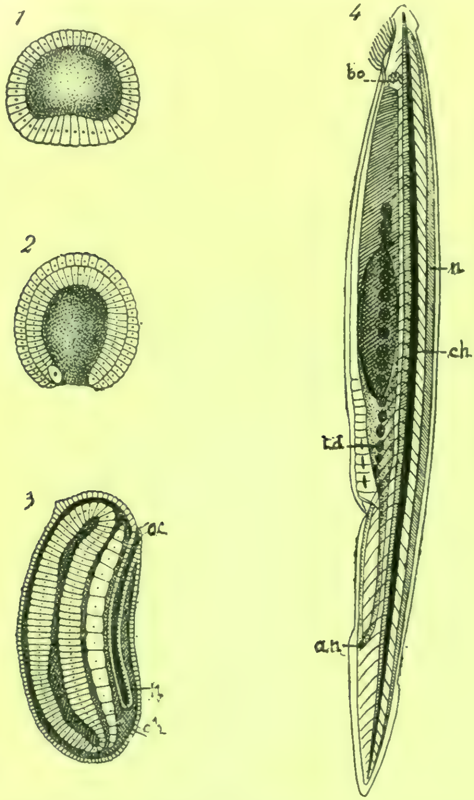
The following extract from Baer, the creator of embryology, is universally quoted.

The embryos of mammalia, of birds, lizards, and snakes, probably also of chelonia, are in their earliest states exceedingly like one another, both as a whole and in the mode of development of their parts; so much so, in fact, that we can often distinguish the embryos only by their size. In my possession are two little embryos in spirit, whose names I have omitted to attach, and at present I am quite unable to say to what class they belong. They may be lizards or small birds, or very young mammalia, so complete is the similarity in the mode of formation of the head and trunk in these animals. The extremities, however, are still absent in these embryos. But even if they had existed in the earliest stage of their development, we should learn nothing, for the feet of lizards and mammals, the wings and feet of birds, no less than the hands and feet of man, all arise from the same fundamental form." (*Origin of Species*, p. 364, 6th edition.)

[2] "There is no reason why . . . the wing of a bat, or the fin of a porpoise, should not have been sketched out with all their parts in proper proportion, as soon as any part became visible." (*Origin of Species*, p. 366, 6th edition.)

There are whole groups of animals, in which the embryonic forms differ little from the adult forms: there are others on the contrary, where the undeveloped form does not enable one to imagine what the final result will be. Spiders undergo only very slight metamorphoses; but even amongst insects the changes are unequal.

history of the evolution of the individual, is the epitome—in some sort the shortened recapitulation of the evolution



FIGS. 51-54.—Some of the phases of the *Amphioxus*, representing the changes common to all vertebrates. 1. Planula phase; 2. Gastrula phase; 3. the Embryo; *ch*, central column, or dorsal cord; *n*, nerve tube; *cc*, external orifice of nerve tube; 4. Adult Amphioxus; *bo*, mouth; *an*, anus; *tb*, digestive tube; *ch*, dorsal cord; *n*, nerve tube.

of the species. In other words, *Every individual repeats in brief the phases through which the species has passed.*

This fundamental law of bio-genesis rests on the law of *heredity at corresponding ages*, enunciated by Darwin: every

creature repeats the stages through which its ancestors have passed. Thus a fish and a mammifer resemble each other during a long period of their development, because both of them repeat the phases through which their common ancestor passed, which was the first of the vertebrates.[1]

In this manner are explained not only the embryonic resemblances, but also the anomalies which mark the development of certain animals. The theory also explains metamorphosis and Alternation of Generation.[2] The repetition in this case, instead of being rapid, is very slow; the insect, which is adapted to its surroundings, remains for some time in one stage, in which perhaps the species remained for long centuries. By this theory is also explained why the passage through these various conditions is so rapid that at times some are passed over; as experience shows that the law of heredity always tends to exercise itself prematurely in the descendants. Thus are explained certain differences which occur in two parallel lines; as it is plain that a recently inherited trait may have a considerable effect on the history of the creature. Thus also is explained the regression of certain insects whose singular property it is to have a more perfect state as larvæ than in their adult condition: this is the effect of faithful reproduction of the previous state of the species. Thus the

[1] "At whatever age a variation first appears in the parent, it tends to reappear at a corresponding age in the offspring. . . . I could give several cases of variations (taking the word in the largest sense) which have supervened at an earlier age in the child than in the parent." (*Origin of Species*, p. 367, 6th edition.)

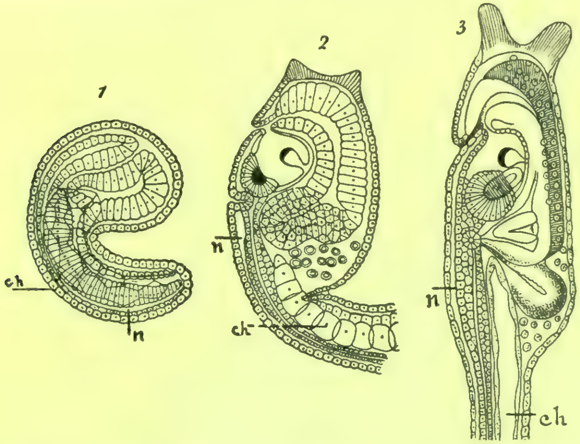
[2] The various ways of development must be distinguished:

1st. The creature rapidly attains its adult form; as with the vertebrate.

2nd. Some animals only arrive at the adult form after a long sojourn in intermediary forms; as with those which undergo metamorphosis, the frog is first a tadpole, insects are first larvæ, then nymphs or chrysalides, before attaining to the perfect insect; but these different states succeed each other in the same individual.

3rd. In this state certain lower animals only arrive at their final condition by phases undergone by distinct creatures; this is the case with those having Alternation of Generation, as the aphides (phylloxera) and the medusæ. . . .

Tunicaries[1] (Fgs. 55 to 57) commence with a spinal cord resembling that of the vertebrate before descending to its final form. This is also the case with the parasitic crustaceæ, the cirripedes[2] (Figs. 59 to 61), etc.



FIGS. 55-57.—Successive phases of an Ascidian. 1. The Embryo with well-developed tail, dorsal cord, and nerve tube; 2. Larva, when hatched; 3. Larva, two days old. The tail which contains the dorsal cord will disappear in the adult.

It does not follow that a mammifer was ever a zoophyte, or one of the cœlentarata, a worm or a fish, for these species come from branches already detached from the common trunk,

[1] "L'œuf des Ascidies (tuniciers) (Fig. 58), donne naissance à une larve libre, à organisation supérieure se rapprochant de celle des vertébrés. Cette larve possède une branchie pharyngienne, analogue à celle des vertébrés inférieurs, un système nerveux dorsal formé d'un cerveau et d'une moelle épinière. Le corps, dans son ensemble, présente une grosse tête et une longue queue, laquelle est munie de muscles métamérisés qui servent à la locomotion. La larve (têtard) de l'ascidie est donc réellement un vertébré. Quand le têtard d'ascidie se fixe, il subit une série de modifications régressives, qui aboutissent à une forme adulte beaucoup plus simple que la forme larvaire." (Perrier.)

[2] "The larvæ of the cirripedes, in the first stage, have three pairs of locomotive organs, a simple single eye, and a probosciformed mouth, with which they feed largely, for they increase much in size. In the second stage, answering to the chrysalis amongst butterflies, they have six pairs

and then fixed by their characteristic traits in their own form. It is the same in a tree, the sap which nourishes all the branches proceeds from the same trunk; that which supplies the lower branches is divided at once, but that which finds its way to the upper branches does not separate itself until

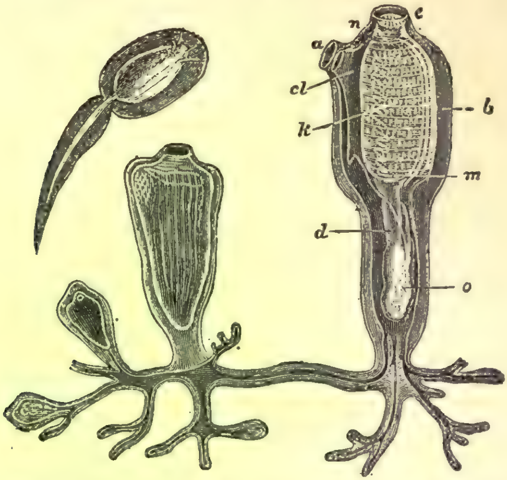
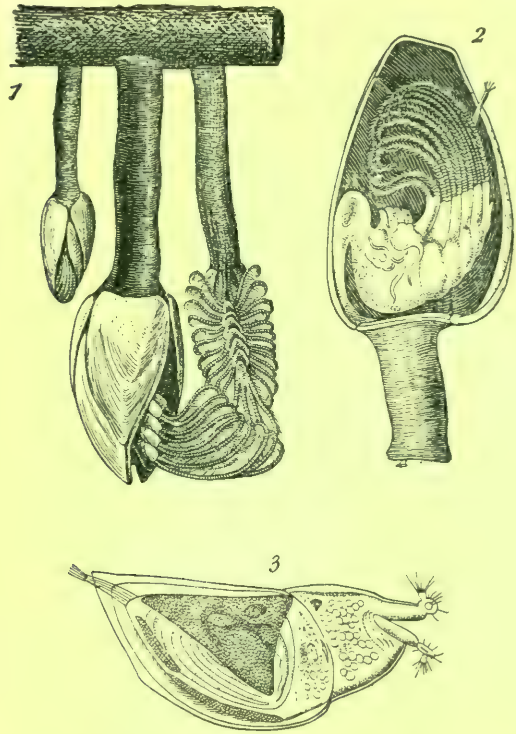


FIG. 58.—Ascidia (growing attached); to the left the larva of the Ascidia with a tail; when this larva is fixed the tail disappears. *e*, the mouth; *a*, the anus; *b*, the covering; *k*, respiratory organs; *m*, entrance of digestive tube; *d*, intestines; *o*, ovary; *cl*, cloaca; *n*, nerve ganglia.

later. The objection has been made that the embryo does not represent stages in which the species have existed, as it would be impossible for it to live before it had reached its appointed time; but this assertion seems to be not well

of beautifully constructed natatory legs, a pair of magnificent compound eyes, and extremely complex antennæ; but they have a closed and imperfect mouth, and cannot feed: their function at this stage is, to search out by their well-developed organs of sense, and to reach by their active powers of swimming, a proper place on which to become attached and to undergo their final metamorphosis. When this is completed they are fixed for life: their legs are now converted into prehensile organs; they again obtain a well-constructed mouth; but they have no antennæ, and their two eyes are now reconverted into a minute, single, simple eye-spot." (Darwin, *Origin of Species*, p. 365, 6th edition.)

founded, since if the embryos were in an environment suited to their condition, they could live, after the manner of those animals which undergo metamorphoses and alterna-



FIGS. 59-61.—Cirripedes (*lepas anatifera*). 1. Group of barnacles, attached to a floating piece of wood. 2. A single one, with one shell removed. 3. A young barnacle, free and unattached.

tion of generation; but as a rule heredity causes them to hasten, thus leaving them unable to sojourn in the intermediate phases.[1]

[1] The salamander is a curious instance. It is known that the tadpole of the common salamander has gills, and passes its existence in the water; but the *salamandra atra*, which lives high up among the mountains, brings forth its young full-formed, without gills, and incapable of living in the water.

§ 4. *The Theories of Evolution.*

The facts which have just been sketched are the standard proofs generally brought forward by evolutionists. It would be incorrect to consider them as peremptory assertions; to be exact it is better to say that the mind is *led* by them to look upon the *apparent* relationship existing between species (which is undeniable) as the result of a *real* relationship, and of a common descent. Darwin, who was so conscious of the difficulties and importance of the question, spoke with hesitation, "*It seems to me that*" . . . "*I am inclined to believe that*" . . . "*Is it not more simple to suppose that*" . . . etc.

Creationists are not moved by these arguments; relying on facts which will be stated presently, they reject the real relation of the species. Then, again, for the creationist there is no interest in the theory of descent, nor does the question of the formation of species require an explanation, since God is the direct and immediate author. To the evolutionist, who thinks it better to attach himself to the idea of descent, belongs the task of explaining "how the innumerable species inhabiting the earth have become so modified as to acquire the perfection of form and adaptation, which justly excites our admiration" (Darwin). In other words, if evolution exists, how is it carried out?

The question is divided into two parts. 1st, How—that is under what influences and according to what law—are the organic variations produced in living creatures? 2nd, How do the varieties thus produced become persistent and increase so as to form characteristic groups?

The answers to these propositions offered by naturalists are

But the young pass through an embryonic stage in which they resemble tadpoles furnished with gills; if they are then taken . . . and placed in water they will swim as well as the tadpoles of the common salamander. This aquatic organisation has no reference to the future life of the animal, nor is it an adaptation to its embryonic requirements; it has reference solely to ancestral adaptations, it repeats a phase in the development of its progenitors. (Observations made by Mr G. H. Lewes.)

termed *evolutionist theories*, doubtless they are not independent of facts, but they do not emerge from the domain of *hypotheses.* Perhaps these two points have not been sufficiently distinguished and kept apart.

1. *The formation of organic varieties.*—Logically this is the first question presented to an evolutionist[1]: before enquiring how a characteristic is transmitted, becomes fixed, and is increased so as to form a species, it would be interesting to know how it is produced. It is a well-known fact that living creatures vary,[2] since there is not a family, animal or human, in which the young do not differ from each other by some traits; under what influences are these variations produced? Do they follow a law?

Under what influence?[3]—According to Lamarck variations are due to the direct action of the physical conditions of life, and to the reaction of the organism itself against these con-

[1] According to Yves Delage, if the theory of a common descent be true, all new species are the result of persistent varieties, preserved by heredity.

[2] Following Maupertuis and Girou, Weismann thought at first that variations were simply a reproduction of ancestral characteristics, but now he admits that some characteristics are entirely new. Lamarck was of opinion that species were capable of variation in order to transform themselves; but Darwin considered rather that they varied incessantly whether they transformed themselves or not. All characteristics, whether anatomical, physiological, or even psychological, are susceptible of variations.

[3] In a recent work (*La structure du protoplasme*), M. Yves Delage assigns three chief causes of variation—spontaneity, conditions of life, and reproduction.

Those variations are considered to be *spontaneous* of which the cause is unknown: they show themselves either in the individual, animal or plant, which lives in exactly the same conditions as its equals. These are generally the most marked variations. Darwin cites as an example the instance of a mare producing successively three foals without tails.

The conditions of life are the most fruitful causes of variation. Thus the races of domestic animals differ from the natural races in those characteristics which are due to the special conditions of domestication, such as captivity, regular habits, repose, or hard work, abundant or varied feeding. In a state of nature the principal changes are due to climate and food. It is true that some instances are given where a very decided change of the conditions of life produced no apparent variety. Thus the Dutch, in spite of 300 years spent in Africa, acquired no negro characteristics. Certain plants transported from

ditions. The change in the environment creates fresh wants in the living creature; to fulfil these wants fresh efforts are made; "the sustained use of any special member strengthens and develops it, giving it power in proportion to the length of time required for the effort; the want of use of any organ insensibly weakens and deteriorates it, gradually diminishing its forces, and at last causing it to disappear altogether." The modifications thus produced have only become fixed by heredity.

Etienne Geoffroy Saint-Hilaire attributed more influence to the environment than to the active adaptation of the organism. But this influence caused by the surroundings was more apparent in the case of embryos in the course of development. He was led to accept this theory by the study of "monstrosities": in his opinion the organic variations were fortunate "monstrosities," produced suddenly on the young and preserved by heredity.[1]

America to Europe, or *vice versâ*, remained unchanged. These exceptions prove nothing against the influence of environment; they only show that we know nothing of the laws of this influence.

Generation also serves to influence the modifications of the characteristics. Asexual reproduction (of which Darwin speaks, p. 363, 6th edition), or by budding, represented by some animals in the case of parthenogenesis, produces few variations. Sexual generation is much more effectual. Thus in the human race children inherit the combined characteristics of both father and mother. The variations are then proportional to the individual differences of the two parents.

[1] In Yves Delage's *La structure du protoplasme*, pp. 796-813, there is an interesting study on variations which the egg and the embryos can undergo. He distinguishes between the plasmatic and the somatic variations.

Les variations *plasmatiques* atteignent directement le plasma germinatif, soit pendant la formation de l'œuf, soit pendant la maturation, soit par sa fécondation même.

Les variations *somatiques* sont celles qui atteignent directement le corps, soit dans l'organisme développé, soit dans l'organisme en voie de formation, et qui peuvent produire une variation jusque dans le germe de l'être qui en dérivera. Ces modifications proviennent soit de la mutilation, soit des effets de l'usage et de la désuétude, soit des maladies, soit des conditions de vie.—Les *mutilations* n'ont d'effet que si elles enlèvent la totalité d'une espèce de tissu, comme le foie, la rate. . . . —Il en faut dire autant des effets de la désuétude.—Les *maladies* ont des effets héréditaires lorsqu'elles atteignent la

It might almost be said that Darwin has neglected the subject of the formation of varieties; he glances at it in the beginning of his book (ch. i.). "Every variation," he says, "has no doubt a determining cause, but it is as impossible to hope to discover it as to say why a cold or a poison affects one man so differently from another." In the meantime he severely criticises those naturalists "especially of the French school who attribute all modifications to the 'monde ambiant.'" He attaches very slight importance to the effect of habit, or to the use or disuse of the various members and organs. He considers that the preponderating cause of variations must be looked for in the progressive development and organisation of the body, and the persistency of the creature. The proof, he says, is that we see similar modifications appear under conditions which differ, and again, dissimilar modifications under conditions almost analogous.

M. Giard[1] thinks that the progress which physics and biology have made gives a better chance of success when searching out the causes of variations. He divides them into direct and indirect factors; the direct are the physical environment (climate, light, temperature, drought or humidity, the physical and chemical composition of the soil and water, the mechanical surroundings), and the biological environment (alimentation, parasitism, symbiosis . . .), the indirect factors are the reactions of the living organism against the physical environment (adaptation, convergence), the reaction against the biological surroundings (mimicry . . .).

A classification does not suffice to elucidate so difficult a question; we consider it to be true that the influences

constitution du protoplasme cellulaire : ces effets sont d'ailleurs différents, car tantôt c'est une immunisation, pour la variole par exemple, et tantôt c'est une aptitude à contracter le mal, comme l'influenza et la goutte.—Parmi les *conditions* de vie, les effets du climat et de l'alimentation sont seuls bien certains pour la modification du germe.

[1] Giard, *Les facteurs de l'évolution*, *Revue scientifique*, 23 novembre 1889 ; *Le principe de Lamarck et l'hérédité des modifications somatiques*, *Revue scientifique*, 6 décembre 1890 ; *Histoire du transformisme*, *Revue scientifique*, 1er décembre 1888.

which decide the variations cannot be stated with any precision.

What law is followed?—Are these modifications produced by chance, and outside the domain of order? Either this question has not been sufficiently considered, or it has been decided, with little examination, in favour of chance.[1]

When Geoffroy Saint-Hilaire, however, studied the influence of environment on embryos and the birth of monstrosities, he believed in the existence of a preconceived *plan*; and he considered every variation capable of acquiring permanence, as one more step taken towards the complete realisation of a plan traced by the Creator. In fact, as will afterwards be stated, it is not easy to see how variations which were absolutely without rule, could in the end bring about order so striking as that which we notice as evident in the parts so well adapted to each other in the same organism; and in relations so perfectly graduated in the species amongst

[1] M. Yves Delage (p. 234) ne veut pas qu'on parle des lois de la variation. Il y a seulement des faits généraux qui se vérifient assez souvent pour qu'il y ait intérêt à les énumérer.

Les organes nombreux sont plus variables quant au nombre et quant à la forme que ceux qui sont uniques ou peu nombreux (Isid. Geoffroy Saint-Hilaire). Cela tiendrait, suivant Darwin, à leur moindre importance physiologique.

"Domestic races of the same species differ from each other in the same manner as do the closely-allied species of the same genus in a state of nature, but the differences in most cases are less in degree." (Darwin, *Origin of Species*, p. 11.)

Plus un organe a déjà varié, plus il tend à varier encore (Sageret). Les éleveurs savent que, pour obtenir une variation déterminée d'un organe, il faut s'appliquer à produire des variations quelconques de cet organe, il faut *l'affoler*: quand on y est arrivé, on peut diriger ces variations désordonnées et produire ce qu'on veut.

Les êtres soumis à des changements quelconques dans leurs conditions de vie ne commencent à varier qu'au bout de quelques générations (Darwin). Cette règle est loin d'être incontestable.

La différenciation organique favorise la production des variations, mais limite leur étendue (Krause). A mesure qu'un organisme s'élève on remarque en effet deux choses: 1° il est plus sensible aux modifications du milieu et plus apte à en suivre les variations; 2° mais il est aussi plus sensible aux causes de destruction, de sorte qu'il périt plutôt que de subir des modifications profondes.

themselves. Darwin's *Natural Selection,* as we shall see, has an eliminating and conservative, not a creative power. The law, therefore, according to which the variations are produced, is not known to science.

2. *How are the Variations rendered permanent and decisive?*[1]—This portion of the question has been more extensively treated, and has had more light thrown upon it. Lamarck decided it very summarily by showing that heredity was the chief factor; he did not apply himself to the searching out the means employed by nature for maintaining and increasing the effects of heredity. Darwin's merit was in bringing into prominence, with a most extraordinary skilfulness of analysis, and a wealth of evidence, the part played by *Natural Selection* in the formation of species. Often the word *Darwinism* is used in the place of evolutionism or transformism; this is an error, as Darwin was not the creator of evolutionism.[2] Darwinism, or the chief feature of Darwin's work, is the system of Natural Selection, which is the part most profoundly studied in this vast question of transformism. A short sketch will be given of the reasoning of this English philosopher.[3]

[1] "Les variations se répartissent en deux grandes catégories : les variations lentes et continues, les variations brusques et discontinues.—Les variations lentes ne peuvent donner des formes nouvelles qu'à la condition de se majorer, de cumuler leurs effets d'une manière quelconque (adaptation et hérédité des caractères acquis, ou sélection ou combinaison de ces divers moyens).—Les variations brusques constituent d'emblée des formes nouvelles, mais il faut qu'elles se reproduisent avec régularité dans la descendance.—Enfin pour que ces formes nouvelles deviennent des espèces, il faut qu'elles ne soient pas fatalement détruites, après une existence de quelque durée, par une tendance atavique plus forte que les conditions biologiques." (Y. Delage, p. 287.)

[2] Darwin thought it well to separate the cause of evolutionism from the system of Natural Selection; and he wrote to Lyell, on the 12th of March 1863, "I am more than ever satisfied with my theory of selection; but that on which I especially congratulate myself is that I see the idea of the fixity of natural forms abandoned; this is the important point for science, while my theory is interesting chiefly to myself."

[3] It will not be devoid of interest to give a résumé of a criticism on selection, taken from Y. Delage (*Structure du protoplasme,* p. 371, and following):

"La sélection naturelle est un principe admirable et parfaitement juste.

It is well known that organic variations are produced amongst domesticated animals and cultivated plants. As the species have the property of transmitting these variations by heredity, the breeders can, by a skilful choice of the

Tout le monde est d'accord aujourd'hui sur ce point. Mais, où l'on n'est pas d'accord, c'est sur la limite de sa puissance, et sur la question de savoir si elle peut engendrer des formes spécifiques nouvelles. Il semble bien démontré aujourd'hui qu'elle ne le peut pas." Voici les arguments qui le prouvent.

1°. Les causes de variations étant plus faibles que les causes de fixité, celle-ci doit nécessairement l'emporter sur celle-là.

2°. La sélection est impuissante, parce que la plupart des caractères qu'elle est censée avoir développés sont inutiles et ne lui donnent pas la possibilité de s'exercer.

3°. Il est de nombreux caractères utiles que la sélection n'a pu former parce que leur utilité ne se montre que lorsqu'ils sont complètement développés.

4°. Les variations, même lorsqu'elles sont inutiles à tous les degrés, le sont trop peu pour créer un avantage donnant prise à la sélection.

5°. La sélection des variations accidentelles ne peut engendrer les espèces, parce que ces variations sont isolées, et que, pour constituer un avantage réel, elles devraient porter sur plusieurs caractères à la fois.

6°. La sélection est impuissante parce que les variations sur lesquelles elle pourrait s'exercer sont sans cesse détruites par la génération sexuelle.

7°. La sélection n'est pas la vraie cause de la formation des espèces, car, si elle était réele, si faibles que fussent ses effets, elle transformerait une espèce en un temps beaucoup plus court que celui qui est évidemment nécessaire pour cela ; et, pour transformer une espèce en un temps raisonnablement long, la protection nécessaire est si faible qu'elle devient illusoire.

"La conclusion de cette critique (p. 391) est que la sélection est impuissante à former les espèces. Son rôle cependant n'est pas nul. Mais il se borne à supprimer les variations radicalement mauvaises et á maintenir l'espèce dans son caractère normal. Loin d'être un instrument d'évolution pour les espèces, elle garantit leur fixité."

This criticism, it must be noted, is not directed against evolutionism, but against Darwin's hypothesis of evolution. According to M. Yves Delage, the Darwinian form of evolutionism is false ; but this does not touch the fundamental principle of the common descent of species. Often an error is made, and the criticism of Darwinism is considered to be that of evolutionism. M. Yves Delage believes fully in the common origin of species, only he explains their formations differently from Darwin. As has already been said, according to him, the formation of species is due, never to their individualities when feeble, and rarely to their powerful idiosyncrasies, but almost always to the permanence of the general variations which affect the greater number, and can be brought to bear on many characteristics at the same time. (Pp. 813 to 826.)

producers, make permanent varieties and races so different from the original that they *might be considered* as new species. From this *artificial selection* come the races of animals which man has created for his pleasure and use: hornless cattle, merino sheep, animals for slaughter, horses for racing and for draught, dogs for hunting, and watch dogs.

Persistent variations are also produced amongst wild animals, especially when emigration or some other change has led to alterations in the conditions of existence. Amongst these variations some are useless to the animal, and some useful. The former, not being of assistance, may disappear from want of use, or from the defeat of those possessing them; the latter, being of great service in the struggle for existence, have aided the survival of those thus endowed, and who were able to transmit these advantages. In this way does *Natural Selection* act; and it resembles somewhat the artificial selection; the breeder who chooses the reproducers and isolates them, is replaced in nature by the struggle for existence, which preserves the fittest, and by the *cataclysms* which separate them.

This, therefore, is the unconscious action which takes place.

The struggle for existence is the natural consequence of the exuberant fecundity of living creatures. If this fecundity were not counterbalanced, the earth would no longer be rich enough to nourish its inhabitants, nor vast enough to contain them. In this struggle the feeblest, or rather those with fewest advantages, perish. The best endowed, or perhaps the best protected, remain masters of the field of battle. Thus is manifested clearly the inexorable law, *the survival of the fittest*. If a living being survives, however feeble it may appear in some ways, it has been preserved by advantages perhaps unknown. It would be a mistake to confound the fittest with the strongest—cunning, agility, colour, a sting, an acrid secretion, tough skin, something defective in its appearance, all these causes would help an animal to triumph over its enemies.

The struggle is not only with regard to food, but reproduction, since certain creatures, with the variation which distinguishes them, might become extinct because they lacked opportunity of reproducing themselves.

The sexual selection, which is carefully carried out in the human species, is not unknown amongst the animal species.

Thus in each generation a real choice is made of those individuals who possess the most advantageous modifications. The conquerors transmit these advantages to their descendants, and heredity makes them permanent in the line of descent. These traits are acquired for ever, and this constitutes *the law of permanent characterisation.* If in virtue of the law of divergence [1] individuals who have come out of a certain group, form themselves into a new species, it is not by the destruction but by the modification of the characteristics previously acquired.

Voluntary emigration and *great cataclysms* have isolated species with regard to formation, have prevented crossing with individuals of the same descent, and have permitted new characteristics to become fixed and accentuated. The general or partial cataclysms were, according to Darwin, a sufficient cause for the separation of the zoological and botanical provinces.

To this system, so powerfully conceived and so logically stated, two objections have been raised. 1st. Since artificial selection, as conducted by man, produces races only and not new species, how can natural selection, left to itself, form species, and even genera and classes? Darwin replies to this that we call races, those groups which have descended from a common stock, but that they often differ more than the species and genera found in a wild state; and that if the

[1] Thus Darwin says (p. 81): "The more diversified the descendants from any one species become in structure, constitution, and habits, by so much will they be better enabled to seize on many and widely diversified places in the polity of nature, and so be enabled to increase in numbers."—Translator's Note.

breeders have succeeded in producing quickly, important varieties, it is not until centuries have passed, and after many tentative efforts, that nature can produce an equivalent. 2nd. Natural Selection is blamed in that it does not explain the transformation of the individual, the creation of new organs, the formation of instincts, etc. The fact is, as was said above, Darwinism is only an incomplete theory of evolution; one more complete would explain the birth and persistence of the advantageous variations; but Darwinism explains only the permanent characteristics, of the law of whose production it knows nothing.

§ 5. *The Excesses of Evolutionism.*

In the first edition of the *Origin of Species*, which appeared in 1859, Darwin was comparatively moderate in his views; his theory only embraced animal and vegetable species; these were descended by way of evolution from three or four primitive forms created by God. This prudent reserve was not retained by the disciples of the great naturalist. After a time the Darwinian theory was taken out of the domain of the natural sciences, and made to answer the purposes of philosophy, so that the whole universe became enchained in its vast synthesis, and many noble minds captivated by its all-embracing character.

The first application made of transformism was to Man. Following the example of Mlle. Royer, Vogt, Moleschott, and Büchner, Darwin was compelled to write a book on the animal descent of Man. Notwithstanding the beautiful and convincing experiments of Pasteur, the school taught the spontaneous origin of life as an indispensable dogma: since God was to be excluded at every point, as well at the beginning of life as at its different manifestations. With Hæckel, Herbert Spencer, Littré, Taine, Renan, etc., we were to arrive at a universal monism, by virtue of which, the laws of physical mechanics, in grouping or dispersing inert atoms

alone, explained all, from the fall of a stone and the development of a plant, to the consciousness of man and the organisation of societies.

Far be it from us to forbid to naturalists the right to philosophize; to carry out their purposes it is necessary for them to search into the laws which combine facts, and thus lead up to the causes producing those phenomena. But they must walk by design not by chance; they must not construct hypotheses with insufficient foundations; nor, above all, must they promulgate these hypotheses as articles of scientific faith. Now this is exactly what has happened with regard to the question under consideration. Darwin formulated a theory, imposingly grand it is true, but still only a hypothesis; it was in fact very incomplete, as it solved only a part of the problem of the genesis of species. And yet on this insecure and trembling basis, philosophism raises an immense construction, under the plea of scientific unity, which the facts of a non-assertive science, and the reasonings of a clear good sense, help to demolish.

We shall briefly examine what is to be condemned in these excesses, in order the better to disentangle the particular question of the origin of living creatures.

1. *The theory of evolution cannot apply to man.*—Before discussing this point in a special chapter, we will give here only the fundamental reason which certainly excludes man from transformism. The idea of evolution implies the idea of progress and of development in the same object, the same faculty, but it excludes the idea of a fresh creation. By evolution is intended the ascent of a living creature up the ladder of organic perfection, even of psychological perfection, inasmuch as it is dependent on organism; but a complete change of nature is not intended, nor that the being should acquire what was not present even in the germ in his ancestors. Now man is something more than an animal; he is not a more developed, more intelligent, cleverer, more industrious animal; he has another nature, although he possesses a body

which resembles that of superior animals. In fact, the mental and spiritual activities which characterise him point to faculties and nature of a spiritual order; whereas all the operations of an animal, even of the highest, confine it within an inferior circle of matter and sensibility. Philosophy studied attentively makes this profound difference patent; the psychological studies of Romanes, the disciple and inheritor of Darwin, have not shaken this important thesis. Hence our assertion that evolution, even had it realised the progression which unites all animals in one nature, could not have produced that new creation which is known as an intelligent and free man.

2. *The theory of evolution cannot be applied to the origin of life.*—We need not here retrace the arguments of a question already sufficiently discussed. We will make only two remarks; the first is that the facts alleged in favour of evolution have nothing in common with the beginnings of life; the second is that the facts and arguments which are opposed to the spontaneous formation of primitive life keep their full force.

That the facts and hypotheses concerning evolutionism have nothing to do with the origin of life is evident. If the facts establish relationship between living species, they do not therefore efface the distance separating minerals and vegetables. When the question arises of the influence of environment, it concerns transformation and progress of organisms already existing; never the transitions from the inanimate to the animate world. Whilst the struggle for life can make those species the prevailing ones which have the greatest advantages amongst animals and vegetables, the minerals engage in no struggle to guard their existence, nor attain any progress.

It is no less certain that the facts and arguments which oppose spontaneous generation are unassailable. No one, after the experiments of Pasteur, doubts that all known living beings are born of parents which resemble

them. The induction which includes the production of life in all time, in an absolute and uniform law, is the least disputed of all the arguments based on modern science.

How has evolution exceeded its bounds in a way not permitted by truth? In virtue of an unbounded confidence in the capacity of physical laws, and of an ill-founded persuasion that the physical universe is all-sufficient in itself to account for any phenomena.

The discoveries in the domain of physical sciences have been marvellous. The law of the transformation and conservation of energy has thrown much light on all the facts of nature. Even in the phenomena connected with life and the acts of man, the truth of this law is verified infallibly; no energy either creates itself or is lost; no phenomena but are called forth by physical energy, nor are produced without a loss, or rather a change of physical energy. But if this law enlightens, it must not be allowed to blind us. This it would do if we forgot that these exchanges and transformations of energy do not include all the constituent parts of phenomena; that they have modality as well as quantity; that this modality, which is never capricious, but always orderly, depends on a power other than the blind force of physical energy. In life, for instance, the law of conservation of energy directs the amount of transformed force; but a power inherent in the living matter determines the modality. And because this power is not the fruit of physical forces alone, it follows that inert matter cannot of itself become life.

The belief that science is dishonoured in bearing testimony to a Creator, becomes more deeply implanted in the learned world. Apparently this is the result of two causes. 1st. The modern tendency towards unbelief, propagated by a press which is much estranged from science; studious men, without due thought, have allowed themselves to fall under its influence, for the preoccupation attendant on the maintenance of a scientific reputation inspires a certain amount

of respect for human or finite causes. 2nd. The absence of critical science in certain religious circles; either from a mistaken piety, or from the lack of solid study, the direct interventions according to the creationist's theory have been multiplied, and these have been put forward as the solution of all difficult problems.

To counteract both the one and the other, a further education of the mind is necessary.

With regard to science there is no dishonour in recognising that the world cannot be explained by reference to itself only; that is a thesis of philosophy which requires to be treated—examined—with the same depth and earnestness as others. If the intervention of the First Cause was necessary at the moment of the first physical movement—the first vital movement—the first intellectual movement—why should this not be conceded?

On the side of religion neither the critical faculty nor circumspection should be lacking; "ne fides ab infidelibus derideatur"; since immature and ill-founded affirmations produce powerful reactions in the opposite direction. The intervention of the First Cause is admitted only when absolutely indispensable, and then only after an earnest examination of the proofs. This is neither to repel nor to deny God; since it would redound more to His Glory to create the causes, than to take immediate action. He is not thereby the less objective and personal.

3. *The Universal Monism of Spencer is not authorised by the theories of the evolution of species.*—Those philosophers who, following Spencer, Littré, and Taine, maintain that the same mechanical laws govern the intellectual, moral, and physical world, and the progress of societies only borrow analogies and phrases from the theory of evolution as it is used in Natural History. The attempt made by Taine, not only to assimilate but also to identify the moral and physical laws, was entirely without foundation.

As in all false systems a part of the truth is found in

monism; it is important to disentangle it, in order to show that monism does not logically follow from it, is not logically deduced from it.

The physical world as it presents itself to our view, appears certainly to be the fruit of a slow and progressive evolution; created as it was in a state of chaos, the matter became organised, little by little, under the dominion of physical forces, according to the very probable hypothesis of Laplace. The world, enriched with plants and animals, with the striking variety of form we see to-day might also be the fruit of a slow and progressive evolution; palæontology teaches us that living beings, at first so simple, gradually became more and more perfect; that these changes were evolved passively under God's hand, or actively by the efforts of nature under the influence of external conditions; in any case progress was made. Humanity itself makes progress; beginning as it did in a very elementary social and intellectual state, it has increased little by little, every fresh generation raising itself by means of scientific and social advantages acquired by the one preceding it; if history shows that decadence in some cases followed on great prosperity yet the fact remains, that considered as a whole, humanity has raised itself. Thus it is possible, in the physical world—in the animated world—and in the human world to announce progress, even evolution, if need be. But monism does not consist in this; it teaches that these three worlds only make one, whether by their nature, or by the powers which direct their evolution. As their nature is identical, it is supposed that the animate creation came spontaneously from the physical world and that humanity proceeded in the same way from the animal world. As the laws and the powers which preside over their destinies are the same, the formulæ which explain the mode of formation of the physical universe, describe the formation of peoples and society in general.

The real fact is that these three evolutions are parallel and not consecutive. The evolution of the physical world began

from the first, and it continues unceasingly towards the determined end still at some distance, under physico-chemical powers. At a later period, the evolution of the animate world commenced, but as has been already said, life did not proceed from a purely physical action on the mineral matter; a superior influence to any in the mineral world formed the first living creature, and conferred on it the mysterious power of sustentation, growth, and production. At last, at a much later date, the human race began, in which we find something more than a simple animal progression; the property of intellectual and moral order, which characterises man.

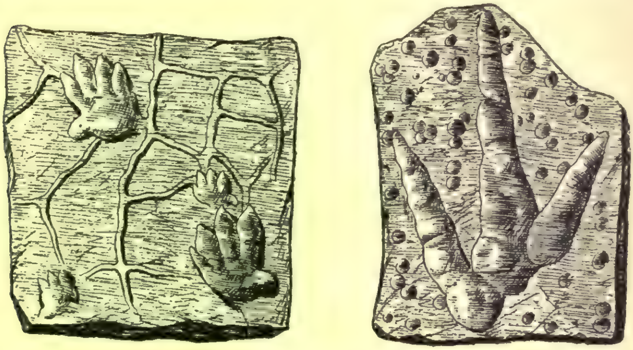
The physical universe was evolved by a slow transformation from its potential, to its actual energy. The living world also was transformed as slowly under the action of environment, and owing to its internal plasticity. The human world is modified and progresses by the elements or characteristics which each generation adds to the inheritance of the past.

It is patent, that the idea of evolution, however readily admitted, does not lead to this monism, which is, moreover nothing but a modern form of the ancient materialism.

4. *Supposing evolution of species to exist it cannot be considered the result of chance.*—In this proposition we arrive at the heart of our subject. We consider it as certain, and in demonstrating its truth we shall prove that evolution does not impair the fact of the existence of God, the proof of which philosophers have always drawn from the order of the world. If evolution exists it has followed a preconceived plan, and a law of order. We are not careful to prove evolution, but if others consider it proved, they must at least recognise this characteristic that it acts in accordance with a law laid down by God.

In all places where law and order are conspicuous, we feel instinctively that there must be an organiser. If a clock is seen to be going, if a watch is found in a desert, that is sufficient to show that an intelligent civilized man has passed. No one would suppose that the clock had made itself or that

the watch is the fortuitous result of some possible combination of atoms moved by the wind. When the geologist comes across traces of feet or hands in the schist, and the old sandstone, he does not hesitate to conclude that some Labyrinthodon or Dinosaur has traversed that region (Figs. 62 and 63): if some sceptic promulgated the opinion that possibly these pretended remains might be only some play of nature, or merely some curious effect of mechanical forces, the geologist would affirm, and with reason, that these doubts would overthrow all science and all reasonable induction.



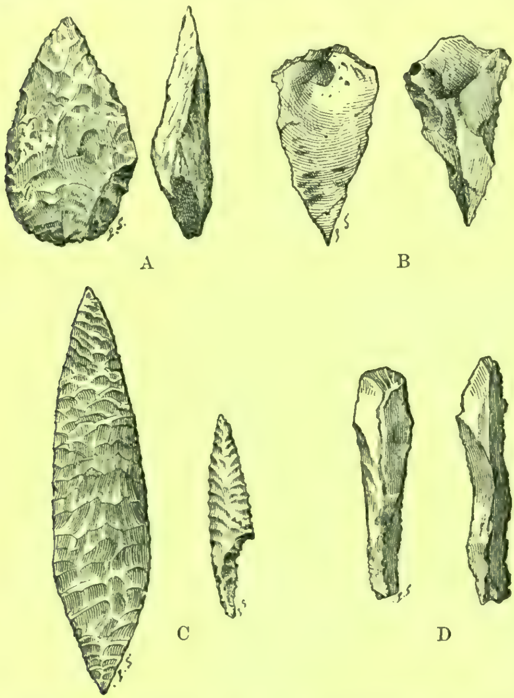
Figs. 62, 63.—Footprints of the Labyrinthodon and of the Dinosaurius found in triassic beds.

In the same way the shaped flints found in the Quaternary caves prove that intelligent man has laboured there; and it is possible to distinguish, with care, and by the help of certain characteristics, the flakes which are the result of physical force and those which are the work of intelligent man (Figs. 64 to 67).

No doubt these objects could be one of the many results of combinations which the atoms drawn by physical force might take; no doubt it is not possible to decide mathematically whether a certain object is the work of mind or the result of chance. But man's good sense travels more rapidly than mathematics, and reason is more powerful than subtilty,

it can distinguish at a glance that which is ordered, or arranged, from that which is not, that which is the result of knowledge, and that which is the work of chance.

Why should this clear insight, which is used without hesi-



FIGS. 64-67.—Characteristic flints of the four sub-divisions of the Paleolithic age.
A. The flint implement of the type of those found at Chelles.
B. An arrow-head of the type found at Moustier ; the two sides.
C. Arrow-heads similar to those at Solutré.
D. A Scraper like those of La Madaleine ; front and back view.

tation by the learned as well as by the people, fail just at this point, and discover only an abstraction when the organiser is the Supreme Being? Again, when the fine traces of the Labyrinthodon make it plain that they were made by the creature itself, would it be possible to imagine that the living

animal was the mechanical result of chance? The surface of the flint is an undeniable proof of an intentional shaping, because order and completeness are discovered in it; and should man, the author of this work,—infinitely more complicated and subject to a higher ordering,—be the result of unconscious physical actions?

Order is manifest in living nature; it is manifest in the correspondence and adaptability of the parts in each individual; it is manifest in the power which leads the species belonging to the two kingdoms to advance; it is manifest in the marvellous evolution of the germ, in which is seen the attainment of each individual, with such certainty and unfailing regularity, to the adult form belonging to the species. This order cannot be explained by environment nor by Natural Selection, nor by the law of growth and symmetry of parts, since all these factors are powerless to produce a harmonious series of events, and to preserve, in spite of multifold obstacles, this harmony when once established.

Even if all the varying degrees of complexity were demonstrated between the perfected eye of a mammifer and the simple ocular spot of a medusa; or between the ear divided into three compartments belonging to terrestrial animals, and the small auditory opening of the worm, this ascending progress of an organ does not nullify the idea of an Organiser; He has left traces of Himself in the most humble forms of our sensory organs, as in the highest.

Order is apparent everywhere, as much in the organisation of the individual as in the succession of the species; therefore if evolution has taken place, it is under the hand of God, and follows a law of development laid down by God. This law may be unknown to us, but it exists.[1] It is precisely under

[1] Sans doute rien n'existe que par la volonté du sublime auteur de toutes choses: mais pouvons-nous lui assigner des règles dans l'exécution de sa volonté et fixer le mode qu'il a suivi à cet égard? Assurément, quelle qu'ait été sa volonté, l'immensité de sa puissance est toujours la même, et, de quelque manière que se soit exécutée cette volonté suprême, rien n'en peut diminuer la grandeur." (Lamarck, *Philosophie zoologique*, t. i. p. 56.)

this form that restricted or spiritualistic evolution (as opposed to materialistic) presents itself.

§ 6. *Restricted or Spiritualised Evolution.*

We shall try to explain clearly that form of evolution towards which the learned Catholics incline, who give themselves up to the study of natural science. It is called "*spiritualised*" because it recognises not only matter and physical forces, but God the Creator, and the human soul; it acknowledges the hand of God at the origin of the world, at the origin of life, at the origin of man, at the origin of the law of evolution; it sees the traces of the human mind in those operations which take place in man outside the sphere of the senses, and which distinguish him from the brutes. It is called *restricted* because it avoids those excesses which we mentioned above, and it considers that the works of Lamarck and of Darwin have only thrown light on the problem of the formation of the species.

According to those who espouse this system, it gives their right value to the important reasons which are adduced in favour of evolution, and it does not jar against the principles asserted by the neighbouring sciences.

1. *The manner in which restricted evolution takes scientific knowledge into consideration.*—It is averred that the process of human knowledge leads to the discovery of secondary causes, more and more numerous, and that God appears less and less as the immediate author of all natural phenomena. Philosophers agree in saying that God gains in glory as the First Cause what He seems to lose in activity as secondary cause: since, according to the old saying, "*Melior est causa causæ, quam causa causati.*" [1]

[1] We like to quote the words recently written by M. Farges: "L'évolution des espèces, aurait-elle existé, ne saurait supprimer les nombreux arguments qui nous prouvent la contingence du monde et la nécessité d'un Etre nécessaire. Bien plus, l'évolution des espèces, si elle avait eu lieu, serait elle-même une merveille nouvelle d'ordre et d'harmonie, qui viendrait s'ajouter à

When science has demonstrated that the equilibrium and movements of the stars and planets were the effects of a general law of attraction, and when it has admitted the grand hypothesis as very probable and worthy of God, which (according to Kant and Laplace) attributes the formation of the heavenly bodies and their divers conditions to the physical evolution of a nebulous mass, is not modern science authorised in believing that God lays down a law of evolution for living creatures *also*, in which all forms of life are potentially included?

Moreover, the creation of an organism so complex as a mammifer, due to the natural evolution of an unformed germ, is a fact not less wonderful than the creation of the genealogical trees of the animal and vegetable species. If God is the First Cause of the evolution of a germ which will produce an organism from parts so differentiated, why should He be the second and immediate cause, and not the First only, of all the organic differences which distinguish the species?

This restricted evolution is not less just to God's wisdom than to His power. In fact, whilst the creationist's theory supposes that God intervened unceasingly to retouch the works of creation during the long geological periods, evolution supposes that God created the world in such a way that it could afterwards progress under the dominion of natural and general laws. If God had intervened, it would have been to supply apparently insignificant characteristics; here to add a fold to the shell of a Paludina; there to cut the partition of an Ammonite more finely; elsewhere to add chalky matter to cartilages which yielded too much. Whereas the species modify themselves under our eyes, by forming races, and enjoy the incomprehensible power of helping to raise

toutes les autres merveilles d'ordre par lesquelles nous prouvons la nécessité d'une Intelligence ordonnatrice. Elle confirmerait la nécessité de cet Ordonnateur bien loin de le supprimer; et, *bien loin de supprimer la création, elle serait un des modes de la création.*" (*Annales de philosophie chrétienne*, décembre 1897, p. 324.)

what would otherwise be a lifeless body, to the participation of life; why, therefore, should all organic progress have needed in the past the immediate intervention of the Creator?

It is no doubt owing to the force of this consideration that M. de Nadaillac, one of the declared adversaries of evolution, acknowledges that the evolutionist's conception is more religious than the other theory, because that supposes, "le Tout-Puissant procédant par créations brusques et successives, remaniant et modifiant son œuvre à travers le temps et l'espace, comme le sculpteur pétrit la glaise et ébauche les contours de la statue qu'il médite." (*Congrès scientifique catholique de 1891*, 8ᵉ section.)

There still remains another point favourable to restricted evolution which seems to have been too little brought forward. With this theory the long succession of living creatures before the appearance of man finds a new and important meaning; even if no man were conscious of them, even if they had left no traces, they were indispensable links in the long chain reaching to the present time. When gathering the fruit hanging on a tree, we are not concerned much with the roots which nourished it, the woody fibres which bear it, or with the leaves whose functions have been of service to it; and yet each separate cell has been multiplied, and has been replaced by others that this fruit might grow and ripen. In the same way, during these thousands of centuries in which life pulsated under the fertilising benediction of God, the varying forms rising higher and higher, and expanding, prepared nature for man, in whose midst his advent took place.

Finally, and this is the strongest argument in its favour, restricted evolution lays under contribution every argument drawn from the facts explained at the commencement of this chapter. It recognises the ties of relationship between the species, and explains it by the descent from a common ancestor. The palæontological succession and the laws of embryology keep their due importance under this theory.

In dealing with theories in general, and Darwinism in particular, they reject none of the preservative effects of heredity, nor the eliminating power of Natural Selection. On that point on which Darwin and the transformists are silent—viz., the causes and the law of the production of variations—they point to the intervention of order and the Creator's action; only, instead of recognising the Finger of God as a secondary cause in every variety produced, they look upon it as the First Cause, creating the law of vital tendencies—mysterious tendencies—under whose influence the variations are produced.[1]

2. *The manner in which restricted evolution escapes the difficulties of religion and philosophy.*[2]—M. l'Abbé Hy, authorised Catholic professor of Angers, was occupied with this thought when he wrote recently: "Ainsi entendu comme un simple moyen de création, qu'il a plu à Dieu de choisir de préférence à d'autres, la genèse des organismes de parents communs n'a rien d'inconciliable avec les plus saines notions philosophiques ou avec les dogmes révélés." (*Rev. des fac. cath. d'Angers. Les plantes fossiles*, avril, 1895, p. 588.)

If difficulties were to be raised against the hypothesis in question, they would naturally proceed either from the sacred writings, or Catholic tradition, or Christian philosophy. Now it is easy to conclude peace with these three powers.

With the sacred writings.—If the Church decides on no fixed interpretation with regard to this subject, the sacred text does not solve the difficulty. As far as is known to us,

[1] In the preface of l'*Evolution des espèces organiques* du P. Leroy, le P. Monsabré expresses this opinion that the theory of evolution, "loin de compromettre la croyance orthodoxe à l'action créatrice de Dieu, ramène cette action à un petit nombre d'actes transcendants, *plus conformes à l'unité du plan divin et à l'infinie sagesse du Tout-Puissant*, qui sait user avec ordre des causes secondes pour arriver à ses fins" (p. 4).

[2] This point has been treated at some length by P. Zahm, C.S.C., *L'Evolution et le Dogme*, t. ii., traduction Flageolet, Paris, Lethielleux.

one single author only seeks a general condemnation of all evolution from the first chapter of Genesis[1]; the greater number of the exegetists consider that, at the most, the Bible says that the living species had God for their Author, in whatever way they were created. It would be equally to force the text to say it taught transformism: by these words, *producant aquæ, producat terra . . .*, Moses does not seem to have intended to establish the proposition that God created the genera and species by conferring the power of reproduction on the living matter at the fitting times.

With the Catholic traditions.—If the Fathers arrive at the unanimous opinion that all species have God for their Creator, yet we soon afterwards see them divided into two schools of thought on the mode of creation. Thus Saint

[1] Le P. Brucker, *Questions actuelles d'Ecriture sainte*, p. 221, acknowledges that it is not well to press too closely the meaning of the sacred writings: "Toutefois les savants croyants ne seront ni beaucoup aidés, ni surtout bien gênés dans leurs travaux, par l'affirmation de la distinction primordiale des espèces, telle qu'elle est formulée dans la Bible. En effet l'auteur sacré ne spécifie nullement en particulier les espèces qui sont directement sorties de la main du Créateur; il ne dit rien non plus de leur nombre. Les botanistes et les zoologistes demeurent donc *très libres* pour reconstruire selon leurs observations les généalogies de chaque règne vivant."

M. Vigouroux, dans son *Manuel biblique*, t. iii. p. 516, dit bien que le darwinisme (il veut dire l'évolutionisme) est une "erreur condamnée par la théologie," mais il ajoute que c'est "en le considérant tel qu'il est accepté par les athées, qui admettent l'éternité de la matière et qui prétendent expliquer par ce système l'origine de tous les êtres." Restricted evolution is evidently not in this case. This M. Vigouroux recognises (p. 509, note): "Il faut observer qu'il existe des transformistes modérés, qui repoussent l'interprétation antichrétienne de la théorie de l'évolution. L'évolution a d'ailleurs été admise de tout temps; elle n'implique pas par elle-même les conséquences fausses qu'on en tire."

This is the opinion of P. Corluy (*Spicilegium*, t. i. p. 198): "Tacet scriptura modum quo terra varietatem specierum produxerit, an statim, an decursu temporis, an cum specierum firmitate omnimoda, an cum relativa duntaxat. Sed de sensu disputari posset quem scriptura hic assignet nomini *mîn*." *We* think that the sacred writings refer all the species expressly to God, but without stating in what manner God produced them, whether by immediate action or by evolution.

Augustine[1] declares that in these matters where there is no question of dogma, the solution belongs to the domain of experiment and reason. No authoritative decision of the Church having been made, even since Darwinism has caused such violent debates, spiritualistic evolution is not in opposition to traditional thought.

With the Christian philosophy.—We call the philosophy by this name which, soon after the Christian era, the Fathers borrowed from the wisest of the ancients, and which the doctors of the Middle Ages taught and developed with so much vigour, and which begins to flourish again in the Catholic schools of thought after an unhappy oblivion of several generations. Restricted evolutionism does not appear to contradict any accepted axiom of this school.

The School teaches positively that nature has received order

[1] St Augustine has often been quoted as having predicted and explained the theory of evolution. This is not correct, as he apparently had no suspicion of it. Still he shows us that on such matters we should take large-minded views. According to his idea God created all, at one time, thus all the species at once. Nevertheless as they did not all appear at the same time, but successively, he affirms that God only created them at the beginning *per seminales rationes.*

"Ista quippe originaliter et primordialiter in quadum textura elementorum cuncta jam creata sunt, *sed acceptis opportunialibus prodeunt.*" (*De Trinitate*, lib. iii. c. ix.)

"In semine ergo illa omnia fuerunt primitus, non mole corporea magnitudinis, sed vi potentiaque causali. Quid enim ex arbore illà surgit aut pendet, quod non ex quodam occulto thesauro seminis illius extractum atque depromptum est." (*De Genesi ad litteram*, lib. iv. cap. xxiii.) Les évolutionistes n'ont pas manqué d'exploiter cette belle comparaison d'un monde s'épanouissant hors des éléments primordiaux, comme un arbre sort tout entier de la puissance de son germe. Nous ne pensons pas que saint Augustin enseigne par là la descendance commune des espèces : ce serait Delbœuf qui se rapprocherait le plus de la pensée du saint Docteur, lorsqu'il enseigne que les germes de toutes les espèces furent créés au commencement, et que les espèces apparurent successivement, à mesure que les circonstances extérieures favorisèrent leur éclosion. (*Revue scientifique*, 28 dècembre 1895.)

St Thomas Aquinas, following St Augustine's opinion, teaches that God did not create all the species at one time *in fact*, but only *causaliter*. "Non ergo tertia die productæ sunt plantæ in actu, sed causaliter." S. Th. i. p. q. 69, art. 2. It is evident that this word *causaliter* leaves us great freedom.

and a final object; this object proves the existence of a supreme organiser; but it has already been shown to what extent restricted evolution respects this argument, both with regard to the development of species and the development of the individual.

The School further teaches the invariability of the essence; thus as many living species as there are, so many distinct and different essences are there. Thus the living species are invariable, and are not transformed.[1]

Be it so,—the essences are invariable in themselves; but the School considers that one essence can make way for another. When for instance, oxygen and hydrogen combine to form water, the Schoolmen do not say that the essences of the oxygen and hydrogen have become modified, but that they have disappeared to make room for another, that of water. When St Thomas Aquinas teaches that in his embryological development, man has at first a vegetative soul, then a sentient soul, and finally a spiritual soul, his idea is not that each of these souls has become modified and transformed into the highest soul, but that the lower kinds have disappeared (*reducitur in potentia materiæ*) in order to make room for another (*quæ educitur ex potentia materiæ*). There is a substitution of essence as soon as there is a substitution of form. Thus the intrinsic invariability of the essence does not oblige the creatures to preserve the permanence of their first condition. If observation shows that in the course of time, a living being has undergone great transformation, it may be affirmed that the new forms arise in proportion as the new morphological conditions are produced by environment.

But is it absolutely certain that there are as many different essences as there are species in natural history, or even as many as there are genera? Is there any distinctive mark which will enable us to affirm that two animals or two plants

[1] This is the basis of the argument brought forward by M. Farges against evolution. (*Annales de philosophié chrétienne*, décembre, 1897, p. 325.)

have different essences? The morphological differences are examined, but what sign is there that these differences mark a distinction of essence, and not only a variety of the same essence? Physiological differences may be noted, but are these as patent between the different groups of the same kingdom? Or the habits of animals may be investigated, but the same difficulty always recurs, that of deciding the value of the differences necessary to distinguish the essences.

Between minerals and living creatures the distinction is clearly defined; also between animals and men. Living creatures have that which minerals do not possess, viz. life; animals have sensation, which plants have not; man performs acts spiritual in their nature, but which are foreign to animals. It is clear that these distinguishing notes warn us of a difference of essence. But it is not thus in each kingdom; moreover, there are certain teachers much attached to the pure doctrine of this school, who declare that the difference of essence between the species of the same kingdom cannot be demonstrated philosophically.[1]

To say that living species have not a common origin because they differ in their essence, would be to argue from the unknown. It would be better to say, if the species have a common origin, perhaps the differences between them are not essential. However difficult the problem of the origin of species may be, it is without doubt more accessible than that of distinction of essences.

It is somewhat in these terms that the restricted evolutionists bring forward their plan of reconciliation between the assured facts of science and the eternal principles of sound philosophy. Perhaps at some future day the opposing parties may agree to meet on this common ground. Nevertheless there still remain many opponents of evolution, and we will finish this study by bringing forward their arguments.

[1] Thus M. Vallet, *Prœlectiones*, t. ii. p. 206, 5th edition, only attempts to demonstrate the essential difference of the mineral, vegetable, animal, and human kingdoms, feeling that the distinguishing notes of the species could only appear as accidental.

§ 7. *The Opponents of all Evolution.*[1]

The theory of the common descent has raised opposition from two quarters, the greater number of Catholic writers, and a small number of naturalists by profession.

The defenders of the Catholic Faith, seeing that irreligion made a weapon of evolution with which to attack dogma, had to choose between two ways of procedure to justify their position. Either they considered evolutionism as indifferent in itself, and only combated the exaggerated consequences which illogical impiety sought to draw from it:—a small number of authors, following the example of P. Bellinck, a learned Jesuit of Namur (see *Études religieuses*, 1868), took up this position—; or they identified the idea of evolution with irreligious thought, and united the two in the same condemnation; this is what has more frequently happened, and numberless refutations have appeared, supported at the same time by philosophical principles and experimental science.

Some distinguished naturalists have opposed transformism. Starting with Cuvier's ideas on the fixity of types, de Quatrefages, Flourens, Agassiz, Faivre, Godron, Hébert, Blanchard, de Nadaillac, etc., have rejected evolutionism in general and Darwinism in particular. De Quatrefages, the eminent professor of the Museum, is the principal writer of this school; he has explained his ideas in two volumes of great value: *Darwin et ses précurseurs français*, and *Les Emules de Darwin*.[2]

[1] Certains critiques, d'ailleurs très bienveillants, nous ont fait observer que, dans notre première édition, nous avions insuffisamment exposé les objections contre l'évolutionisme. Nous ne pensions pas avoir mérité ce reproche. Néanmoins, dans cette seconde édition, nous tenons à reprendre tout notre travail, désireux de donner à toutes les difficultés sérieuses l'expression la plus précise.

[2] We know of no book which states the difficulties brought forward against evolutionism more powerfully than Darwin's own, *The Origin of Species.* No author has seen the objections more clearly, nor does he disguise their value, and at each difficulty he explains why he still abides by his own opinion. In p. 385 he says, "Such is the sum of the several chief objections and diffi-

But it is necessary to notice two shades of opinion amongst the partisans of the fixity of species. One set concludes simply: *we are ignorant* as to the formation of species, we only know they are not transmutable, and that neither Lamarck nor Darwin has discovered the true law of their creation. Thus spoke De Quatrefages. The others go further, and say: The species are not only not the result of any evolution whatever; but they have required the direct and immediate intervention of the Creator.

To state the question precisely, it shall be presented in a restricted form. 1st. Only those objections will be given which are urged against the common origin of living species; those which concern monism will be passed over in silence, since the origin of life and the origin of man are treated elsewhere. 2nd. Only the scientific arguments will be used, and not those of the philosophic or religious order; since we are persuaded that the question, if restricted to the origin of the species of each kingdom, is a purely scientific one. Moreover, that idea of order which results from the distribution of organs in the individual and species of each kingdom, has been already made sufficiently prominent. It is to be regretted that the problem is not always stated under similar limitations, since frequently certain facts or certain reasons are applied to the origin of species which really refer only to the origin and differences of the kingdoms.

Not less regretable is the confusion between evolutionism and Darwinism.[1] Evolutionism asserts the common descent

culties which may be justly urged against the theory; and I have now briefly recapitulated the answers and explanations which, as far as I can see, may be given. I have felt these difficulties far too heavily during many years to doubt their weight."—Translator's addition to note.

[1] In Lord Salisbury's famous speech, delivered at Oxford in 1894, on the *Present Limits of our Science*, he directed his chief attack against evolutionism, which he confounded with Darwinism. The speaker recognised the fact that the doctrine of the fixity of species is very generally abandoned now; a concession of which those are oblivious who bring against evolutionism objections which can only properly be levelled against Darwinism. He says

of species; Darwinism attempts the explanation of the formation of species by Natural Selection.

Evolutionism, since the time of Lamarck, has not ceased to make progress amongst naturalists; but Darwinism, though at first received with enthusiasm, has little by little crumbled away, and Natural Selection now is only looked upon as one out of thousands of factors brought into action by Nature for the differentiation of species. An argument, which is of force against Darwinism, would be of no value against evolutionism. A passage from the book of some learned writer directed against Darwinism is taken in a wrong sense if used against evolutionism. How often authors, very much attached to evolutionism, are quoted by an unpardonable misunderstanding, as opposed to a system which they have adopted.

Against evolutionism thus understood—that is against the common descent of species—three principal arguments are brought forward.

that time would not suffice to name the successive transformations "from the Medusa to Man"; this criticism is only advanced against those who admit the Darwinian hypothesis of a slow transformation. Moreover, no biologist has ever placed a Medusa in the genealogy of Man. He next refuted the theory of Natural Selection as the cause of the formation of species; but this criticism again is directed against Darwin and Weismann simultaneously, and not against evolutionism in general.

In a reply to Lord Salisbury, Huxley pointed out that the orator had abandoned the theory of the immutability of species, and that the Darwinism criticised by him is only one of the theories of evolution, consequently evolution remains untouched.

Weismann, feeling himself attacked by Lord Salisbury, undertook the defence of Natural Selection; he pointed out that even if Natural Selection were abandoned, evolution would remain. Also, he did not wish this to be construed into a declaration of dogmatic atheism; outside the range of phenomena there remains a domain which he calls the "unknown."

Herbert Spencer, replying in his turn, dwelt chiefly on Lord Salisbury's error in confounding the fact of evolution with one of its explanations. He invited the opponents of evolutionism (who demanded proofs) to furnish examples of direct creation. This article of the English thinker was presented to the Academy of Science of Paris by M. Ed. Perrier. (*Cf. Année biologique*, 1895, pp. 531-533.)

1st. The system of evolution is a hypothesis with nothing to prove it.

2nd. The facts cited in its favour can be explained in a manner at variance with its tenets.

3rd. Some well assured facts are manifestly in opposition to evolutionism.

1. *Evolutionism is a hypothesis.*—This proposition does not present any difficulties: evolutionists and creationists are at one on this point. The theory of the power of attraction is also a hypothesis; the theory of Laplace is another case in point; and, with still greater reason, the theory of descent will probably never be anything more than a hypothesis. M. Yves Delage does not shrink from the following avowal. "I recognise the fact (and it does not alarm me) that no one has ever seen one species produce another, nor transform itself into another, and that there is no recorded observation, demonstrating definitely that this has ever taken place. I refer to a true genuine species, such as are the natural species, and maintaining themselves without the help of man." [1]

M. Blanchard knew that his challenge would not be accepted, when in 1888, at the beginning of his book, he addressed these words to all the friends of natural science. "Show me once for all an example of the transformation of species" (*La vie et les êtres organisés*, preface).

Darwin knew better than anyone that evolutionism is only a hypothesis; therefore he avoided all categorical assertions. For this reason de Quatrefages reproaches him for the non-scientific arrangement of his theory. "You affirm," he said, "that this *appears* thus to you; it *seems better* to you to believe in a change of form; you are *persuaded* that the existing species have descended from a common ancestor. But if the contrary *appears* better to me; if I am *persuaded* that the opposite opinion has a greater appearance of truth;

[1] Delage, *Structure du protoplasme*, p. 184. The author is nevertheless a partisan of evolutionism, for he adds: "Je considère cependant la Descendance comme aussi certaine que si elle était démontrée objectivement."

our *inclinations* have equal weight and force. Scientific reasoning is formed on another basis: in the question before us, well attested facts of changes, starting from established and striking examples, would have to be brought forward in order to arrive at an unanimous conclusion." Far from blaming Darwin for the diffident nature of his statements, the fact that a learned writer presents a hypothesis with diffidence, should rather serve as a recommendation to us, and is a fact worthy of notice.

If evolution be a non-proven hypothesis; must it therefore be rejected? This would be to go too far. In order to reject it without further examination, it would be necessary to have another and better-founded hypothesis on the same question, and that it be susceptible of experimental and ocular demonstration.

If the theory of evolution were totally rejected, the alternative would be the creationist's theory, or intrenchment in agnosticism. As the agnostic refuses to pronounce on the subject, nothing more can be said with regard to him. Is creationism (as understood technically) other than a hypothesis? Have facts been obtained by observation or experiment, showing that the Creator interposed immediately in the formation of species? Evidently not. Having neither on the one side nor on the other categorical facts, we must question Nature and ask her towards which solution the ties of relationship which unite the species, and the differences which separate them, incline? [1]

Can the hypothesis be considered capable of experimental verification? With regard to the past—No. We are dependent on the interpretation of very incomplete palæonto-

[1] M. Yves Delage, p. 185, in a note, makes the following true remark: "Je suis absolument convaincu qu'on est ou n'est pas transformiste, non *pour des raisons* tirées de l'histoire naturelle, mais *en raison* de ses opinions philosophiques." There are two classes of philosophical opinions held on this subject: the materialistic, which desires at all costs to push aside the idea of a Creator; and the spiritualistic, which considers it a more glorious proceeding on the part of the Creator to have created the species by means of evolution.

logical data. With regard to the present—Yes and no. By the help of observations and experiments, we assert that the living forms are very plastic, and consequently very variable. These variations go so far "that the differences in shape as well as in anatomy, existing amongst animals of the same species, and met with amongst wild creatures, are sufficient to account for the formation of distinct and perfectly characterised genera" (de Quatrefages, *Darwin*, p. 230). Are these variations sufficiently distinct to constitute species? It is a question of appreciation, so that on the one side it is affirmed that the production of new species has been observed, whilst on the other hand it is said that only races of the same species exist.

The question whether new species are found in our day would therefore be differently answered according to the evolutionist or creationist tendencies of the judges. For this reason the statement is repeated that the proposed solution of the question of the origin of species is only a hypothesis.

2. *The facts brought forward by evolutionists are susceptible of an interpretation unfavourable to the system, or at the least do not necessarily imply evolution.*[1]—Six were cited at the beginning of this chapter; we will recapitulate them in the same order.

(1) Organic forms are *variable* no doubt, but only in a certain measure. In fact, under the intelligent and prolonged influence of man's action, the variations cannot surpass the limits of the race; this is to be noticed amongst domestic animals, which man has bred for so long a time. When his influence ceases, the races created by him tend towards a reversion to primitive types. Now in the creation of races, nature has fewer resources and less power than man; and in fact only a small number of races exist amongst wild species.

[1] This proposition can be found further developed in two recent writings: Piat, *La Personne humaine*, Paris, Alcan, 1897. Farges, *Annales de philosophie chrétienne*, décembre, 1897.

Thus the variability of form is limited, whereas evolution wishes to show that it is without limit.[1]

(2) There are many striking *resemblances* between neighbouring species; they keep an orderly succession, not in a straight line, but on parallel lines, in such a way as to make a harmonious whole—a plan. But there also exist profound differences, sometimes anatomical, sometimes physiological. If evolution explains the resemblances as readily as the creationist's theory, it cannot so easily account for the genesis of the differences.[2]

(3) *Rudimentary organs* are not opposed to the theory of creation. For, as Darwin says, it cannot be ascertained whether an organ which is rudimentary and useless to the adult, may not have exercised an important function in the embryo; for instance the Pituitary gland, which is atrophied in the brain of adult man, supplied the pharynx of the infant during the first months with nerves. Why should these rudimentary organs not be the result of a degradation which the species has undergone? This kind of evolution *intra eamdem speciem*, seems to have pleased certain authors belonging to the German Catholic School.[3]

(4) *The geographical distribution* of species is quite consonant with the hypothesis of distinct and separate creation; since the Creator could make a wise and orderly disposition

[1] M. Piat rejette la plasticité indéfinie des formes organiques : il en conclut qu'il faut mettre le multiple à l'origine et non l'unité. Cependant il reconnaît aux êtres vivants une grande flexibilité relative. "Les oscillations du monde physique exigeaient dans le monde organique une puissance analogue d'oscillation. Tout n'était adapté et ne pouvait se développer dans l'harmonie qu'à cette condition. Réduite à sa juste mesure, la plasticité devient le triomphe de la finalité."

[2] It cannot be too often repeated that living species must not be classed in a single ascending line, they are arranged as the branches and ramifications of a great tree, where the many parts make a parallel, not a lineal series. To put the species in their natural places is, no doubt, not to prove their affiliation; but in speaking of a genealogical tree we must not be led to look upon it as "un mirage de mots heureux." (Expressions de M. Farges, *Annales*, p. 315.)

[3] M. Farges appears to agree with this idea in conjunction with Delbœuf.

of species in space, as in time, in a plan of successive progression. In the evolutionist theory the distribution of species gives rise to difficulties of interpretation which the sagacity of transformists has not entirely solved.

(5) *The Palæontological succession* only presents two facts favourable to evolutionism. 1st. In a general way, the living creatures appeared according to the order of their organic perfection; strikingly so with regard to the vegetable kingdom, but the fact is also noticeable amongst animals. 2nd. It is possible to follow the variations of certain species through long geological periods; thus the existing horse is connected by imperceptible variations with an ancestor of the Eocene period; imperceptible that is to each generation, but the differences are very great if the first and last types are compared.

The creationists explain these two facts in a manner favourable to their system.

1st. The most perfect creatures could not exist from the commencement, the condition of their surroundings would not have permitted it. How did they arrive at existence? Either God created the species directly—at the moment of their appearance,—or He created the germs of all the living species at the beginning of life, and each germ developed itself as the propitious moment arrived: this is the theory advocated by M. Delbœuf. This system, which is regarded with some amount of favour at the present time, by the opponents of evolution, lends itself to the explanation of all these facts; but it possesses the drawback of resting on no foundation either of observation or experiment. In fact it furnishes a subject of uneasiness as to the fate of these thousands of germs, which wait, under critical conditions, for the distant hour of their manifestation.

2nd. Species, whose number cannot be limited by science, are susceptible of modifications; this evolution *intra eamdem speciem*, explains the differences which we find, during the course of ages, in forms of which it is not possible to deny the relationship: if the hipparion be the ancestor of the

horse, that proves that the horse-species has undergone an evolution, and not that all the species have descended from a small number of common ancestors.

Palæontology furnishes other facts which creationists oppose to evolution, these will be considered afterwards.

(6) Finally, if it is not possible to deny the *resemblance of embryos* in the course of development, it is known that all creatures acquire their definite shape, through forms more or less approximate. These resemblances (though often exaggerated) must of necessity exist. They testify that God has left traces in His work of design and unity; they do not prove the common descent of forms. "Le Dieu Créateur, qui est aussi providence et librement soumis à la loi de la finalité, a outillé ces différents êtres avant de les jeter dans la mêlée de la vie. . . . Voilà pourquoi les Cirripèdes, avant de se coller à leur rocher, acquièrent six pattes et des antennes; elles ne pourraient se mouvoir, s'il en était autrement; et elles seraient vouées à une mort certaine. . . . L'Auteur de l'univers a imprimé à son ouvrage un dernier trait de beauté, en le faisant dans l'unité d'un même dessin. Et de là vient que les êtres vivants partent des mêmes germes et suivent à peu près la même voie dans leur développement, aussi longtemps que le moment n'est pas venu d'accuser leur différence spécifique" (Piat, p. 293).

3. *Certain facts are enumerated as being contradictory to the theory of evolution.*—Only those will be noticed which have the most weight.

(1) *The permanence of organic forms throughout long periods.* In the ruins of Herculaneum the remains of plants and animals were found belonging to species which had not varied during the space of eighteen hundred years. The descriptions left by Aristotle show that the species studied by him have not varied during more than twenty centuries. When examining the grain and the mummies in the tombs of the Pharaohs, it is found that no variation of form or kind has taken place since the fourth dynasty. Many of our existing

species have not varied since the Tertiary era; and there are certain primitive species which have traversed the whole of the geological periods with no change. Therefore the species have not the plasticity generally ascribed to them. If, for instance, species of the Tertiary era have undergone no sensible change in many hundred thousands of years, it would be impossible to believe in the fundamental and universal variations which evolution would have us do. This argument comes from Cuvier.

If closely examined the force of this fact is quickly weakened. It proves only that species do not alter *invariably* or of *necessity*; it does not prove that species remain immutable, when circumstances call for a change. All the examples cited show that species remain stationary under stationary conditions, nothing more. The few species which can be traced back to the Primary era belong to the deep sea fauna, of which the conditions of life do not vary. The species of the Tertiary age remain to all appearance stationary under circumstances which varied little. As for the corn and the mummies of Egypt, they show us only that climatic conditions have remained much the same since the time of the Pharaohs. The true law of the history of species is the following: their stability is assured by, and follows on, the stability of their conditions of life: striking changes in the biological environment would quickly be followed by important variations.

(2) *Astronomy does not allow the time required by evolutionism* for the formation of species. Lord Salisbury himself formulated this objection in his famous speech on the *Present Limits of our Science.* Lord Kelvin (W. Thomson) limits the time which has elapsed since life became freely developed on our sphere as a hundred millions of years. Now the evolutionary biologist makes no extravagant demand in requiring some hundreds of millions of years to bring the living forms of the primitive Monad up to man. Thus there is a contradiction between astronomers and evolutionists.

This argument would be very conclusive if its foundations were solid. But, on the one hand, Lord Kelvin bases his calculations on very debatable data, as was noticed in the first chapter, and as can be seen in reading his *Conferences.* On the other hand, it is supposed that all the variations have been produced very slowly, and that the organic forms are derived from one single creature—the primitive Monad; these two suppositions are entirely gratuitous, and without foundation; they can be given up without endangering evolutionism, and thus the consequences are escaped.[1]

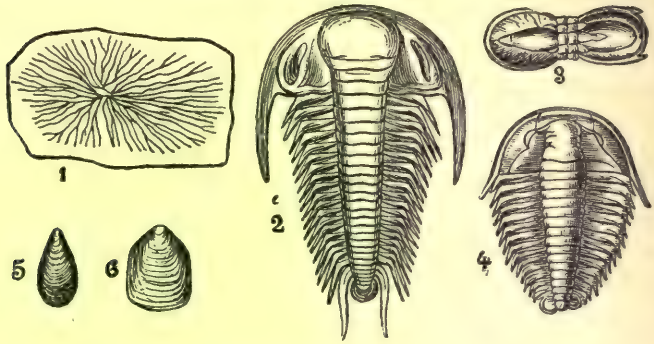
(3) *The Primordial Fauna of the Cambrian Rocks present types already much differentiated.* If the species were produced by a slow evolution from a single primitive form, much time must have elapsed before the differentiation appeared which the lower Cambrian fauna manifests, and of which geology has found the traces. (Figs. 68 to 72.) Now no organic remains are found previous to these; therefore this period coincides with the appearance of life, which shows that life was created with a multiplicity of forms belonging to all the groups.

This argument, as Darwin and M. Gaudry testify, is very embarrassing for evolutionism, which only allows of one starting point for all species. But it is entirely in favour of restricted evolution, which permits of many primitive forms, and is also in favour of the creationist view of Delbœuf, which only admits of evolution as possible *intra eamden speciem.*

In any case we must not exaggerate the force of the argument, since the two following remarks serve to weaken

[1] L'objection tirée du temps par Lord Salisbury est combattue par Spencer à l'aide d'une comparaison très frappante, sinon très rigoureuse. Spencer part de la loi de Fritz Müller, que chaque individu répète brièvement, durant son développement embryonnaire, les phases que son espèce a mis de longs siècles à parcourir. Prenant pour exemple l'individu humain, il remarque que son développement se fait en 400,000 minutes, ou 9 mois. Comme les astronomes, du moins Lord Kelvin, accordent 100 millions d'années pour l'évolution des espèces, une période de 250 ans correspond à une minute de l'evolution du fœtus. La modification inappréciable qui s'accomplit en une minute chez le fœtus, n'aurait-elle pas pu s'accomplir en 250 ans chez l'espèce ? (*Cf. Année biologique*, 1895, p. 533.)

it.' 1st. The absence of fossils previous to the lower Cambrian remains does not prove that life did not exist; the primitive species, unfitted for fossilisation, were unable to leave any trace; these fossil remains, even had they existed, must have disappeared in the complete renovation brought about by metamorphic influence. 2nd. If the disposition of the species had been in a lineal direction, the distance would have been very great between the Trilobites and the



FIGS. 68-72.—Types of Primordial Fauna.
1. Oldhamia (its nature is uncertain).
2, 3, 4. Trilobites, of the Arthropod division (Paradoxides, Agnostus, Olenus).
5, 6. Brachiopods, which have lived through the geological ages (Lingula Antiqua, Lingula Davisii).

equicellular Protozoas. But the recent classifications of living creatures permits the connection of the lower Arthropods with Protozoas by a number of intermediate types. (See *Le Cours de zoologie de M. Ed. Perrier.*) Thus the different branches of the living trunk were able to make their appearance in a short time.

(4) *Evolutionists cannot lay down genealogical chains of the present species* in such a way as to link them to a common trunk. Palæontology does not furnish us with the intermediate forms which must have existed, and would have left traces of the past.

Darwin avows (p. 383, 6th edition), "that this is the most obvious and the most weighty of all the objections which may be urged against the theory." In order to meet it, he could only point to the gaps occurring in the geological records, and appeal to the future, basing his confidence on the constant and more numerous discoveries of intermediate types.

(5) If evolutionism were true, the living creatures should not present distinctive characteristics, nor form well ordered collections, *but be mixed one with another.* It must be remembered that the present species are only remains, that many forms have vanished, that the differential traits are rendered more striking in consequence of the disappearance of the intermediaries which have succumbed in the struggle for existence. It has already been asserted that the incontestable order which our classifications show could not be the result of a mechanical or haphazard evolution, but is the indication of the ordaining power of Creative Intelligence.

(6) Finally, the chief objection made by creationists to evolutionism has always been *the sterility of different species when intercrossed.* This sterility has seemed to show that the species were essentially different, and that it was no more possible to combine them than to combine a square and a circle, and for this reason all efforts made to transform the species had been in vain. (Farges, *Annales*, p. 327.)

Species are sterile when intercrossed; whereas races or varieties are fertile: this is the present law with regard to reproduction. Without being absolute, it is generally accepted. The exceptions to it rather prove the rule than invalidate it. For instance, mules are sometimes fertile, but with limitations; the offsprings of the hare and the rabbit are indefinitely fertile, but they return promptly to the type either of a hare or rabbit.

De Quatrefages attached a great importance to this; the fact, in his eyes, establishes an impassable barrier between the species. "Unhappily," he says, "there comes a time

when Darwin seems to forget the great physiological fact of sterility between the species. At any rate, he disregards the importance of it." "Just as in minerals there are two points to be considered, the crystalline shape and the chemical composition, in the same way," said De Quatrefages, "the morphological traits and the physiological properties, of which the most important is that of fertility,[1] must also be studied." As in the minerals the chemical composition is very much more important than the shape; so with living creatures, the species are more readily determined by their fecundity than by their morphology. Thus even if two species were anatomically almost identical, they could be distinguished by their sterility when intercrossed. Therefore the true characterisation of species consists in the law stated by Flourens: *The interfecundity of species shows them to be identical, the intersterility shows them to be different.*

This universal and constant fact cannot be explained by evolutionists as such. Darwin himself is ignorant of the reason (p. 235, 6th edition). It is easy, on the contrary, to understand that if each species is a true and fixed unit, created by God, with a distinct essence which suffers no admixture, endowed with a certain plasticity to be able to accommodate itself to its environment, that species is preserved from any fundamental alteration by this law. "La stérilité des hybrides (fruits d'individus d'espèces différentes) est une preuve décisive en faveur de la fixité des types, de la stabilité des espèces et de leur variabilité dans des limites assez étroites" (de Nadaillac).

Whilst creationists, during the last fifty years, following de Quatrefages, have always considered this argument as unanswerable, the evolutionists have not looked upon it as of great importance. But their reasons must be stated, if we would be faithful to our rôle as critics.

[1] De Quatrefages, *Les théories transformistes*, *Revue scientifique*, n° du 20 juillet 1889.

Flourens' dictum is far from being infallible. There are many instances of sterility amongst races as well as amongst species; guinea pigs do not ally themselves with their ancestors of Brazil, nor the domestic cat imported to Paraguay with the European kind; the rabbit brought to the island of Porto-Santo, near Maderia, in 1419, will not breed with European rabbits from which it is descended, etc. . . . The hybrids are not always sterile; the offspring of rabbits and hares, and of sheep and goats, have longed proved this fact; the cases of interfertility amongst different races, although rare, increase in the annals of science.

The law of sterility amongst species when intercrossed is easily understood, since it is known that living creatures only have fruitful alliances if they neither resemble each other too closely nor differ too much. If there were two varieties of the same species which became fertile, they would diverge more and more, and the fecundity, small at first, would gradually be lost. Again, between two varieties or species now intersterile, there might and must be intermediate varieties fruitful with the two extremes; if the whole series of varieties existed, we should see a continuous line of productions, but because the intermediaries have disappeared we notice the sterility caused by distance. For instance, we say that all races of dogs are mutually fertile, although the extremes of the lines should be intersterile; if the intermediate races disappeared, and if the historical fact of the common origin were forgotten, one would not hesitate to look upon the extremes of the races as species, characterised alike by physiology as well as morphology.

From this law of intersterility, it seems natural to conclude that all essays to create new species have been and must be in vain. There are two observations to be made on this. 1st. Each time that two varieties are brought forward, which have proceeded from a common ancestor, whatever distance separates them, the creationists only see in them races of the same species, and not different species; thus they do not

avow that the rabbits of Porto-Santo are of another species to the European rabbits. On these premises evolutionists and creationists do not arrive at a mutual understanding. 2nd. When creationists demand that new species shall be produced, they do not always state the proposition clearly. They wish that a new intermediate species should be produced from the horse and the donkey. But it cannot be too often reiterated that if new species are produced it is by the exaggerated divergence of two varieties proceeding from a common trunk, and not by the fusion of two neighbouring branches into a single stem.

Conclusion.

We are now in a position to formulate the following conclusions:

1. The monism may be rejected which unites all creatures, and which teaches the spontaneous passage from matter to life, and of the merely animal life to the spiritual and mental life of man.

2. That the formation of living species is the result of chance, that is to say, of blind mechanical force, is not to be believed; but that each kingdom, animal and vegetable, realises a plan preconceived and ordained by God.[1]

3. How did God execute His plan? The answers to this question are hypothetical. The hypothesis of restricted and spiritual evolution, and the hypothesis of creationism are both very reasonable.

[1] The founders of evolutionism were not aliens to this idea. According to Lamarck, the laws of nature "ne sont que l'expression de la volonté de celui qui les a établies." (*Histoire naturelle des animaux sans vertèbres, Introduction.*) Darwin wrote (*Vie de Ch. Darwin*, par de Varigny): "Je n'ai jamais été un athée, je n'ai jamais nié l'existence de Dieu. . . . Je crois que la théorie de l'évolution est tout à fait compatible avec la croyance en Dieu. . . . L'impossibilité de concevoir que ce grand et imposant univers, avec nos *moi* conscients, a pu naître par hazard, me paraît être le principal argument pour l'existence de Dieu."

4. Towards which system do the facts and analogies, drawn whether from Nature's laws, or from God's ordained proceedings, lead us to incline? Does it not redound more to God's glory, and seem more compatible with His mode of procedure, that He should have created species by evolution, that is as First Cause rather than by successive creations or as immediate cause of each species? [1]

5. If God created the species by evolution, were they produced from one primitive type or from many? In the present state of our science it seems more probable that He placed many simple primitive forms in nature when first creating life. But there are fewer means of guaranteeing this assertion than is the case with the other conclusion.

In seeking to produce precision and clearness in a subject, the ideas of which are too often confused, we have endeavoured to put an end to disputes coming from regrettable misunderstandings.

[1] This conclusion agrees with the opinions expressed by the International Congress of the learned Catholic, as well in 1894 as in 1897. In 1894 the Congress adopted the following resolution: "La section d'anthropologie du 3me Congrès scientifique des catholiques à Bruxelles, loue et encourage les études de ceux qui, sous le suprême magistère de l'Eglise enseignante, s'adonnent à rechercher le rôle que l'évolution peut avoir eu dans le concert des causes secondes qui ont amené le monde physique à l'étàt actuel." (*Comptes rendus*, p. 298.)

With regard to the Congrès of 1897, held at Fribourg, we quote from the account given by M. de Kirwan (*Revue du monde catholique*, octobre 1897): "Le R. P. Zahm, recteur d'un collège de Rome, a, sous le titre de *Téléologie et Evolutionisme*, développé cette thèse qu'il existe un évolutionisme orthodoxe, lequel non seulement n'exclut pas les causes finales, mais en montre la nécessité d'une manière plus évidente encore . . . Si l'évolutionisme ainsi compris n'est pas admis par tout le monde—après tout, il n'est toujours et il ne sera probablement jamais qu'une hypothèse—du moins n'est-il plus en général repoussé *a priori* par aucun esprit scientifique . . . Comme il a bien fallu reconnaître dans les divers camps, que, à la condition d'être maintenues dans des limites rigoureusement scientifiques et dégagées d'hypothèses arbitraires et surajoutées, ces théories n'ont absolument rien de contraire aux vérités de la foi et qu'elles les appuieraient plutôt, les discussions à ce sujet, sans cesser d'être animées, sont devenues moins passionnées."

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CHAPTER IV

THE ORIGIN OF MAN

§ 1. *The Significance and Scope of the Subject.*

THE course of our studies leads us to treat of the origin of Man. If the question is, for many reasons, a difficult one, its importance forbids us to evade it.

In the eyes of those naturalists to whom the human race is only the first in the animal world, this paper will seem a needless repetition of the one preceding it; since the problem of the origin of humanity, in their opinion, must inevitably receive the same solution as the problem of the origin of animals. Those who consider man to possess a privileged nature (in fact a "new and distinct order of being"—Mr Wallace) would allow that his origin might also be distinguished by a privileged or distinct character: even if the Creator had produced other living creatures by means of evolution, there would have been no lack of order in forming "His own image" in man by a special creative act. Since the subject is under discussion, and to prevent needless repetition, we will state at the outset, that we shall investigate in what manner the first man appeared.

In order to go more directly to the point, we shall eliminate for the moment the cognate subjects of the unity or multiplicity of the origin of the human race. Whether the divers races came from one primitive source or from many, the point which occupies us remains the same—is it by evolution or by a distinct creative act that the group of intelligent and free beings who constitute the human race has been produced?

Since we are concerned with facts, it would have been

well had there been authentic records to consult. It would be rash to assert that these records are entirely lacking. How is it possible not to be struck by the legends which are circulated amongst those peoples, who have not been too far degraded by a savage life? They differ, no doubt, on many important points, but all agree in placing the origin of humanity in the hands of a Divinity. Is it not permissible to see in these common traditions, memories, more or less confused, which man has preserved from the beginning.

According to our belief as Christians the Bible contains in all its purity the history of the origin of the human race. Whatever efforts may be made to weaken the force of the high import of the first chapters of Genesis, the plain teaching, clearly expressed, may always be seen, that God by a special and distinct act created the first man.

It is no piece of historical or exegetical criticism that has been undertaken, but what is much more simple—enquiries by a naturalist. Putting on one side the historical records, we shall in all honesty strive to learn to which solution the inductions produced by scientific investigation tend. It will be found possible to state that science,—if it be not forced,—not only does not disturb the faith, but serves to confirm it.

Before Darwin's time, the divine origin of the human race had never been doubted from a scientific point of view; the attack directed against the Christian faith has come from a narrow materialism, rather than from scientific arguments. Certainly Lamarck, in his *Philosophie zoologique*, had applied his principles of evolution to man; he also investigated by what processes of change a chimpanzee, for instance, could develope a human form. But the conclusion at which he arrived as the result of these studies indicates his bent of thought. "These are the reflections which might occur to one's mind if man were only distinguished from animals by his physical organisation, or if his origin had not differed from theirs."[1]

[1] *Cf.* de Quatrefages, *Charles Darwin et ses précurseurs français*, p. 365.

As soon as Darwin's book on the *Origin of Species* appeared, the entire school of materialistic philosophers hastened to apply the principle of Natural Selection to man. The learned English naturalist took the same course, and very soon published his *Descent of Man*.

This opinion of the origin of man, from a pre-existent lower form, necessarily caused intense excitement. It is chiefly in this form that the theory of evolution penetrated to the people. The too favourable reception accorded to it may be easily explained; lovers of pleasure considered themselves freed by it from the restrictions of the moral law; theorists, who were enemies of the soul and of God, found in it a very opportune support to their arguments, when trying to prove that the world existed without God, and that man has no soul.

To-day the theory of evolution is so generally received amongst naturalists, that it is difficult to dispute its conclusions without being stamped as ignorant and behind the times.

It is an entirety of which no part can be separated. "You will be driven to admit all or to reject all," said Darwin, and his disciples were of the same opinion. But how is it possible to attach the same importance to all parts of the theory? Why not make a distinction between what is capable of being evolved, and what is not? Are there not hypotheses which are well founded, others with no foundations, and others simply dictated by prejudice? It is not without surprise that we see men possessed of such intelligence as Spencer making no distinction between soul and body, and teaching that all men proceed from animals, because it is possible to trace the connection between human organism and that of the higher animals.

In order to preserve to science the esteem it deserves, is it essential to subscribe to a materialistic thesis? Is it impossible for the spiritualistic philosopher to be also the philosopher of nature? In the question which occupies us, what

position should they take who believe in the divine origin of the human species?

Those who utterly reject evolution both for the vegetable and animal kingdoms can have no part in the discussion of the origin of man; for if God intervened directly for all living forms, how much rather would He interpose His divine action in the creation of the first man. They are in no need of the arguments which will be brought forward in this paper; still they invoke them in support of their theory. Perhaps, following the example of de Quatrefages, they may be led to exaggerate; anxious to include in one common law the formation of all the species, they might come to the conclusion that the divine origin of man is a proof of the immediate and direct divine intervention with regard to all living species. But since man's nature is singular and apart, independent of the animal nature, why should not the human origin be also of a special singular nature, entirely independent of the law ruling the animal species?

Those who admit that God in all probability created the living races by means of evolution, distinguish in man his two component parts, soul and body. All those holding the spiritualistic views acknowledge that the human soul proceeds directly from the hands of God. With regard to the body, which becomes a human body when joined to the spiritual soul, it is permissible to enquire in what way God became its Creator.

Either the human body was directly fashioned by God out of purely mineral matter, which is the same as saying that evolution takes no part whatever in the formation of man, or the human body was prepared in the hidden counsels of God, during a length of time, by a slow natural evolution, and God would then have created man by infusing the spiritual inflatus in an animated organism, which would be, to acknowledge that evolution might have been used for a certain part in the formation of man.

If this last hypothesis be accepted, a still further distinc-

tion might be made, the reason for which will appear later. At the moment at which God willed to create man, either He made use of the animated organism, such as evolution had prepared, or He perfected it according to the plan He had conceived by adding to it certain special characteristics peculiar to the human race, such as the cerebral development, and the upright position, etc.

These different hypotheses having been set forth amongst Catholics, it seems well to repeat them, that they might throw more light on the significance of the subject. No author has more clearly expressed the possibility of attributing the origin of the human body to evolution than St George Mivart.[1] In his eyes God would still be the Creator of the entire man, of his body as of his soul, but the two would have been produced by different means, the body by the law of evolution, the soul by a special and immediate creative action.

From what has gone before it will be seen that it is necessary to deal separately with the origin of the human soul, and that of the human body. In refuting materialistic evolution by establishing the truth that the soul comes from God by means of direct creation, the fact will at the same time be also established that man is not the result of a blind and inevitable evolution.

In studying the agreement between the human organism and that which is merely animal, it is evident that science itself leads us to believe, as the Bible says, that the body of the first man was fashioned by God's own Hands.

Taken in its entirety, the subject is seen to be of such supreme importance that it hardly needs to be pointed out. The grandest philosophical, religious, moral and social consequences are involved in the solution.

[1] Mivart, *Genesis of Species*, chap. xii., *Theology and Evolution*. It is but right to say that St George Mivart was one of the most steadfast champions of the divine origin of the human soul; it was on this essential point that he was opposed to Mr Romanes, the disciple of Darwin, and who continued his work. In order to refute him Mivart wrote the splendid book entitled *The Origin of Human Reason*, London, 1889.

From the philosophical point of view it is the nature of man that is in question. If man carries a soul in his body, he can only come from God; but if man is only the last link of a series produced by evolution, he participates in the nature of animals and has no immortal soul. As the end of every being is the same as the beginning the destiny of man will not be more glorious than his origin.

In the event of man's animal descent what can be said of religion? With its manifold conceptions it is only a mode of secretion peculiar to the human brain. Being entirely founded on the relations necessary between creatures and the Creator, religion would disappear simultaneously with the idea of creation.

The moral law also has henceforth no existence, since it ceases to be, where a supreme power is lacking which orders and sanctions; that duty which has no other foundation than a sentiment or desire found in man, urging him to be honest, has neither stability nor authority. Moreover, man would be no more responsible for his acts than the animals, of which he is a superior type. Freed from moral responsibility, relieved from the fear of the future, why should he put a curb on his passions?

In order to perceive the social effects which proceed from these pernicious theories, it is not necessary to reason on the subject, it is sufficient to consider the facts. Is it not evident that under the influence of these new ideas, the tone of public morals has become lower, crime has developed, and brutal egoism has increased, etc. . . ?

If man is to retain in his life that dignity and virtue to which, in spite of all, the human conscience remains persistently attracted, he must have other ideas instilled into him, with regard to his own nature, than materialistic evolution.

§ 2. *The Origin of the Human Soul.*

To say whence comes the human soul is to solve the problem of the origin of man. In fact it is the soul which is

the characteristic of man; not only does it decide the nature of his faculties and acts, but it also communicates to the organism itself, the properties which distinguish it. The material parts taken by themselves would be quite indifferent to such and such an organisation: they become a human body from the principle which rules them. The organic parts themselves even are totally indifferent whether they carry out the acts of a purely animal life, or the higher acts of a human life; the physiological energy which they expend, takes that direction to which it is impelled by the interior principle of the being. The nature of man being defined by the very nature of his soul, it follows that the origin of the soul points out also the origin of man himself.

When the first man appeared, whence came his soul? For us the thesis is certain that it was created by God, it could not be the fruit of evolution.

The high import of this assertion rests on the solidity of the reasoning which follows. If the human soul,—if the source of life in man, is of a special nature,—a nature apart, —if it is more than one degree superior to the animal soul, it cannot have been produced by evolution. Now the human soul is by its very nature, of such marked superiority, that it cannot be considered of the same order as the soul of beasts. It is clear that if these two propositions can be demonstrated, the proposed solution may be taken as true.

The first need not detain us since it is not contested by the holders of the theory of transmutation. They are perfectly agreed that evolution only develops what exists, perfects what is already possessed, adds a new degree in the same order of things: evolution modifies a pre-existent nature, it cannot create a new nature. This is a fundamental principle in the schools; it was to guard this truth that evolutionists were led to universal monism. They began by making little of the difference between man and beast, the abyss being bridged over by a hypothesis, evolution could be used for either indifferently. Then the distinction was lessened between

animate and inanimate matter: that done, evolution could then assert, as a biological necessity, in the face of contrary facts, the thesis of spontaneous generation. The most sure way of annihilating the differences of nature was to admit the mechanical conception of the universe: all was to be reduced "from the fall of a stone to the consciousness of man" (Hæckel) to the simple mechanical movement of the inert atoms.

There seems then no doubt, apparently, that the first proposition is equally received by both sides; thus it is the second which will furnish subject for debate. Romanes with the whole of the Transformist School recognised the fact. Hence the problem under discussion turns upon the nature of the human soul. The materialists say that the soul of man, whether it be an active immaterial principle, or a resultant of the forces of matter, is only the soul of an animal perfected, in the same way that the soul of an adult man is the soul of a child, after cultivation, as the soul of civilised man only differs in degree from that of the present savage, or primitive man.

We assert on the contrary that *there exists a* true absolute difference of nature between man and the animals.[1] The arguments which support this thesis will first be stated, before examining the objections which are brought against it.

The thesis has not always been held as unassailable. Thus de Quatrefages, who clearly admitted the real distinction between man and the animals, only gives as proofs the *religion* and *morality* with which man is endowed.[2]

Now these qualities, high though they are, do not seem to be sufficient barriers, indeed they cannot be considered as human faculties, only as means whereby the faculties of knowledge and will express themselves: therefore, unless it can be proved that the faculties of knowledge and of will

[1] "When Linnæus speaks of man in his entirety,—not merely physical man,—it is in such terms that the idea of a *human* kingdom is the result." (De Quatrefages, *L'espèce humaine*, 12th edition, p. 17.)

[2] De Quatrefages, *L'espèce humaine*, chap. i.

are of a different nature in man from those in animals, it might be said that the intelligence of animals might one day produce religion and morals, since they only lack the degree of development. M. de Nadaillac is very far from identifying man and beast.[1] *Consciousness* and *progress* are certainly very weighty arguments in favour of the difference. But in rejecting the difference of nature between human intelligence and that of the brutes, does not M. de Nadaillac undermine the edifice he has reared? Since, should the animal intelligence increase at all, this intelligence would then create consciousness and lead to progress. For the same reason we consider the difference, based on the *superior operations of the spirit*, as insufficient, as is done by modern spiritualists. For if the superior operations of the faculty only are higher, the faculty itself is of the same order; if the faculty prove to be the same, then why not admit that man has arrived at the exercise of these superior acts of this faculty by a fortunate evolution?

Very much firmer is the ground on which Aristotle and the disciples of that school take their stand. Mivart also, in imposing upon himself the task of refuting Romanes, by defending the specific nature of the human soul, and consequently its divine origin, has courageously adopted two distinguishing means of recognition, which are the true foundations of the traditional philosophy.[2] Here is a brief epitome of his method.

The nature of a living being manifests itself by the faculties which come from it. The nature of the faculties is revealed by the operations produced; and the operations are of the same nature as the object chosen. Therefore it would be logical to trace back from the nature of an object known and willed, to the nature of the being who consciously knows and wills it. Consequently the being who grasps ob-

[1] De Nadaillac, *Le Correspondent*, 15 janvier 1892: *Intelligence et Instinct*, 3° article.

[2] Mivart, *The Origin of Human Reason*, Introductory, London, 1889.

jects, disengaged from all matter, such as principles—ideas—abstractions—beauty—goodness—truth—justice—injustice, etc. . . , is by his nature immaterial; having a spirit capable of independent existence, since it is capable of acting for itself.

Now man, taken from any of the human races, and at any age of humanity, has proved himself capable of spiritual operations; he is everywhere endowed with the power of abstraction, and of generalisation, he is an intelligent being according to the strict sense of the word. An animal, on the contrary, which shares with man his powers of sensation, and which knows and pursues objects apparent to its senses, has no power with regard to objects beyond the range of his senses, nor can it grasp immaterial and abstract objects.

Our problem is thus reduced to the examination of two facts; man is endowed, at the same time, with intelligence and with sensible faculties; an animal has only the sensible faculties, it is deprived of intelligence. This is the culmination of the statement, to this point all discussions on the subject lead: any solutions not directed to this point do not run on feasible lines.

We are quite conscious that this question demands developments which would carry it far beyond the scope of this paper; since in order to place the spiritualised solution with sufficient clearness, many concrete facts would have to be examined, which appear not to be in agreement with it. We shall try to trace the line to be followed through the labyrinth of difficulties.

The first fact to be established is the reality of the intellectual power of man.

1. *Conscience* is the keen-sighted mentor, who enlightens us concerning our transactions, and consequently on our nature. If we examine our inner selves very closely we shall see two kinds of acts revealed. The one set proceeds from the senses; they have matter and qualities relating to our senses for their object, they have to do with the particular—dimension—colour, etc., they act through the

senses. Our eyes see, our ears hear; those pictures which are presented to the mind's eye are in a certain sense drawn on the brain. The others proceed from faculties which are entirely spiritual, the objects they embrace are immaterial—abstract—general—all that is independent of size, colour, etc. Such acts are not produced by corporeal organs, although in our present condition they cannot be realised unless the body participates in some degree. They are elaborated by spiritual faculties; but these faculties only act on the impressions made by the organs of sense.

This distinction of the double power in man, is the result of a powerful philosophical analysis; but what it would not be easy for each man to discover by his own powers, it would be possible to prove and verify on himself by reflection. Thus conscience reveals two distinct parts in us; one that we have in common with the animals, the other that man alone possesses and which characterises him. At the same time the feeling of the oneness of our nature is impressed upon us with such force that we recognise the same principle as the moving spring of all operations. Such is the act of reflection by which the soul is conscious of itself, its spirituality and its unity.

But an internal impulse, so lofty, so distinct in its idiosyncrasies, could not fail to express itself outwardly by producing effects equally lofty and characteristic. These effects of the spiritual soul, identical amongst all races and at all ages of humanity, permit man to assert the identity of nature in all beings who resemble him in their organism. Articulate language—morality—religion—progress, etc., these are the external phenomena through which human intelligence radiates.

2. *Articulate language* is at the same time the sign and the result of abstraction and generalisation. Whoever speaks must also think, since all the words of a language, the pronouns as well as the nouns and verbs, are abstract forms, disengaged from particular objects. On the other

hand, whoever makes acts of abstraction would be endowed with language; not because all acts of abstraction, conceived of in the spirit, are necessarily followed by speech, but because it would be difficult to imagine a person—living in society—having general and abstract ideas—without at some time or other employing formulæ to express them. These outward symbols need not necessarily be expressed by the voice, they may be conventional signs of the hands, of the eyes, or made in some other way.

Now this language which is an infallible sign of mind, is possessed by humanity in all latitudes. It is more or less rich and harmonious; but it is nowhere lacking. Look at the deaf-mute, to whose ears the sound of the common tongue never penetrates; rather than the thoughts of his soul should remain concealed, he would substitute a sign language, every movement of which would represent general and abstract ideas. Amongst savages language exists, however poor it may be, it still consists of general expressions, and is always capable of being enriched.[1]

3. *Morality* is another result of intelligence. Indeed the idea of good and evil supposes the consciousness of freedom and responsibility. He only is free and distinguishes good from evil who retains an attitude of conformity with, or opposition toward, a contemplated act and a known law. Morality is found equally in all human races. The feeling which it inspires is not dread of punishment, but the shame of having transgressed an immutable law made known by conscience.

Doubtless the given laws are very various amongst the different nations; doubtless also the customs practised with regard to essential points, such as modesty, propriety, the respect due to human life, differ very much according to the degree of civilisation. But, which is very remarkable, there are no people however barbarous, who have not adopted

[1] See the further development of this subject by M. Piat, *La personne humaine.*

customs and established precedents which plainly show the existence of, and ensure respect for, moral principles.

4. *Religious feeling* includes at the same time the belief in superior beings, capable of influencing our destinies, and a conviction that a part of ourselves will survive beyond death. If Atheism be encountered in humanity, it is an *erratic* condition, to borrow an expression from de Quatrefages. By the natural bent of his mind man is religiously inclined. He does not need education to become religious but to become an Atheist. No doubt instruction is necessary to develope religious belief in a particular form, but previous to instruction the human soul is religious by instinct. This tendency is also the result of human intelligence. In seeking to know whence he comes—who made the world—man feels that he is the offspring of a Supreme Cause, on which he is always dependent: considering whither he goes, man feels that his entirety does not die. In the same measure as the religious ideas are found to be universal amongst humanity, so are they equally wanting elsewhere.

5. *The progress of the individual and the race* is a fact which is characteristic of humanity. Animals are not capable of progress because, says Ch. Richet, "they are condemned to psychical fixity." Whence comes this fixity if not from the powerlessness of animals to make abstractions and generalisations? Whence does man's faculty of development come if not from his mind, which enables him to rise from particular facts to general and abstract ideas? All created things—marked by progress—give evidence of the dominion of a general idea, on particular matter or phenomena. Whilst animals are the slaves of nature, intelligent man dominates and subjugates it.

6. This *subjugation* of the untamed elements and animated creatures to the needs and pleasures of man, is also a sign of his intelligence. Man, belonging to all races—and he only—works in wood, iron, stone, etc., builds dwellings which have no resemblance to himself, and are out of proportion to

his physiological needs. He only lights fires and constructs clothes for himself. He only creates works of art, whose end and object is to express the beautiful, and not for utilitarian purposes. He extends his empire over all animals, tames the fiercest, and brings the most docile into his service.

It would be superfluous to multiply or develop these distinctive marks of human intelligence. As they are to be met with in all men, and are lacking in all animals, they make a line of demarcation which cannot be crossed between the one and the other. However they are of no service with regard to proof, except as they lead to this conclusion, that there exist in man certain spiritual faculties which are wanting in animals. We consider that this conclusion rests on solid reasons which we stated at first and will again recapitulate. The nature of the objects dealt with, reveals the nature of the faculties dealing with them: the objects sought by man and attained only by him, are of a spiritual order; showing that the human faculties are equally spiritual. But a spiritual soul is not of a like order to an active principle concerned with the senses only, and therefore cannot result from it by means of a simple development. Consequently the first human soul, not being a progressive possession, but entirely new, *could* only attain existence by the intervention of a creative power external to itself.

It is well now to listen to the opponents of this proposition, and to mark, if possible, what false interpretation has led them to the error still holding them.

§ 3. *Difficulties concerning the Human Soul.*

Since our teaching on the origin of the human soul is based on the fact of its marked superiority, we must investigate the argument by which our opponents strive to bridge over the gulf which separates man and beast. They reproach us in fact with depreciating animals, and placing too high a value on the lower human races. All the faculties of man, they say, at least in a rudimentary condition, are found in

animals; the savage is an intermediary between civilised man and animals, one who is behind-hand in the march of development: does not a child repeat one by one all the phases through which human intelligence has passed before attaining its present elevation?

1. *The mind of animals.*[1]—Darwin had already made many efforts to discover traces in the acts of animals of that particular intelligence which generalises and reduces to an abstraction. Romanes, his disciple, has developed this conception of his master in a book called *The Intelligence of Animals.*[2] M. Perrier, continuing the thought expressed by both, arrives at the idea of the presence of Intelligence properly so called.[3] M. de Nadaillac also comes to the same conclusion in a series of didactic articles; he nevertheless rejects the idea of the identity of the human and animal natures.[4]

According to M. Perrier animals possess all human faculties — external perception — memory — imagination — power of induction—abstraction—and generalisation; he considers that they also have curiosity—a certain perception of the beautiful—even religiousness and morality.

Though it does not form a part of our plan to enter into a detailed discussion of the facts alleged in favour of the psychical faculties of animals, we shall give the principles which will help us, as far as we are concerned, to solve this problem at once so ancient, and yet so modern.

Far be it from us to abase animals under the pretext of exalting man. We should not say with Descartes that animals are machines only, wisely put together and controlled by the hand of the Creator, whose innumerable springs are so accurately adjusted that the mechanical move-

[1] This question has been very carefully studied in a work by M. l'Abbé Piat, *La personne humaine*, vol. ii. chaps. iii. and iv., Paris, Alcan, 1897.

[2] *L'intelligence des animaux*, par Romanes, Paris, Alcan, 1887.

[3] Perrier, *Le transformisme*, Paris, J. B. Baillière, 1888.

[4] De Nadaillac, *Le Correspondant*, articles *Instinct et Intelligence*, 1891-1892.

ments give the impression of spontaneity, sensibility, perception, and volition.

We readily admit that with the most elementary reasoning faculties, animals judge—take cognizance of things—have the power of movement—of decision—they experience emotions, manifest passions, attach themselves, become irritated, defend themselves, make dwellings for themselves, etc. St. Thomas Aquinas, as a faithful disciple of Aristotle, goes so far as to attribute to them a faculty of combining impressions which amounts almost to a certain imitation of judgment amongst men.

With regard to animals it is possible to distinguish two sorts of faculties: the one sensuous, consisting in the powers of knowing, loving, and of pursuing that which is obvious to the senses, also of retaining and combining the impressions made on the cerebral organ. The others are psychical faculties, and consist in the power of abstracting the idea from the impression and of pursuing immaterial good, and of combining ideas amongst themselves, which leads to reason, morality, religion, and progress.

As has been said above, we attribute all the sensitive faculties to animals; in man only we find the intellectual or spiritual faculties. We believe that all animal acts are confined to the domain of sensibility: in contra-distinction to the doctrine of Locke and de Condillac, we believe that human thought is not merely a collection of transformed feelings.

To come to facts, we consider that the authenticity of many of the most curious amongst them is doubtful. All those anecdotes favourable to animals have been collected; but are the sources in all cases reliable? if they are related in all sincerity, are they entirely corroborated by close observation? if the observation was carried out with all earnestness, how often has not the act of the animal been exalted by the intellect of the observer. By anthropomorphic tendencies we attribute our own motives and feelings

to them; since we undergo the same conditions with regard to the senses, which we see in them, we suppose that they pass through the same intellectual conditions which in us are supersensitive. To attribute these states to them is uncalled for, almost we might say erroneous; since not only do animals fail to prove that they have the same intellectual condition as ourselves but they indicate the contrary.

In fact we find that all well authenticated acts can be accounted for by the work of the senses—that is, that they do not require any faculty which is independent of a material organ. No discussion need be entered upon concerning the results of imagination, dreams, memory, perception, love or hatred, since the existence of these faculties is duly recognised. The difficulties are with regard to those facts which appear to be the result of induction, morality or religion, etc.

Darwin speaks of a monkey who was taught to open the lid of a large box with a stick, and afterwards it used the stick as a lever to move heavy bodies. In order to act thus had the monkey really made an *abstraction* of the *general* idea of resistance to effort and of the power of the lever, from its first act? Is it not more simple to conclude that each resistance awoke in the monkey's mind the picture of the lid of the box, and from association the picture of the stick was also recalled, and that the combination of the old impressions, and the present object resulted in the image of the weight raised by the stick?

When Darwin supposes that the peacock in spreading his tail has appreciation of beauty, has he not interpreted the action incorrectly, or at least given an uncalled-for interpretation? For the spreading of the tail is the inevitable result of muscular contraction, when its passions are aroused, rather than a deliberate act for the purpose of attracting admiration.

No doubt animals warn each other of danger, mutually defend each other, and loyally divide their prey into equal parts: but does it follow that they are impelled by moral

sentiments, or feelings of duty? When men act in this way is it always from a sense of duty? Is it not from reasons closely connected with the senses, such as sensuous affections, fear of consequences touching the senses?

No one supposes that traces of religion are found in a horse when it rears in the dark from fear, or in a dog when it rolls in the dust on hearing thunder. Man and animals are alike subject to fear, and it may show itself by the same symptoms in each. But religion is another thing altogether, it comes from beliefs which are connected with intelligence, it can be, and is, without any signs of fear, and yet it may and does provoke salutary fears.

The greater number of the actions of animals can generally be traced to origins connected with the senses: not one belongs to intelligence properly so called; in order to judge of the most difficult cases it is necessary to take well-known facts.

If animals were intelligent, and had rudimentary reason, as is asserted, they would produce acts which would compel faith in this intelligence. That which we are unable to read in their inner consciousness would then be plain to us by outward manifestations. They would in that case have some formulated language by which we could enter into a participation of their ideas, but they can only give sensible expression to those varying conditions connected with their passions.[1] M. Garner succeeded in discovering in a monkey's voice those tones which give expression to the passions, to hunger, fear, sensual love; but it was not therefore possible

[1] M. Duilhé de Saint-Projet, *Apologie*, p. 397, characterises very clearly the language of animals by those traits which distinguish it from human language:—

1. It is a language entirely emotional, not rational.

2. Animals do not readily indicate their impressions (*non intendit manifestationem*).

3. Animals are physiologically and absolutely incapable of lying.

4. The language of animals does not improve.

See the highly interesting study of M. L'Abbé Piat, *La personne humaine*, vol. ii. ch. iv.

to place himself in relationship with them. They must have possessed feelings of responsibility and have shown signs of volition in preferring supersensible good, to the pleasures of the senses; animals do not hesitate except between two pleasures, or between a pleasure and a pain of the senses. They should profit by the labours of their ancestors, they should make progress in man's school, whereas it is known that the education of an animal only concerns the senses, that it consists entirely of relations established between material signs, that animals do not instruct each other, etc. . . .

We could extend these considerations; they all lead to the same conclusion, that animals do not give evidence of the effects which spiritual intelligence would inevitably produce even if only possessed in a rudimentary state.

But animals show clearly that they are unintelligent, that they cannot reason.[1]

It is easy to understand that the race of monkeys is too low in the scale to invent chemical matches, or to make a combination of ideas as should result in a piece of wood being brought in contact with the live flame. But at least, when a monkey has seen fire made in the house of his master, when he has under his hands all the means required for repeating a lesson which he has received so many times, the preparation of a breakfast, for instance, why does he seem incapable of a series of acts to which intelligence should lead? His instinct of imitation would cause him to perform actions connected by ties of sensibility, and would render him teachable and useful to a certain extent, such as bringing the dishes to his master, prepared by the cook possessing intellect: but beyond actions which have their motive power in the senses, he is incapable, and fails in those demanding individual reasoning powers.

[1] In the *Cosmos* of 21st March 1891 a certain number of facts have been collected, showing that even the most cunning animals, such as monkeys, elephants, dogs, bees, ants, are lacking with regard to that reflection which would characterise intellect. The author treats the subject now under discussion with great skill.

Very often one has been struck by the chain of successive acts of an animal, and been led (too quickly) to consider them the result of preconceived reasoning. As M. Fouillée has well said,[1] the succession of acts called forth by increasing needs, presents the same concatenation of events as that produced by organised desire. Each fresh want is necessarily connected with the preceding impression; this chain of successive acts is required for the preservation of the individual; but this connection, which we discover after the events, was not necessarily foreseen by the animal.

The logical conclusion of the preceding consideration is that it is not depreciatory to animals to confine them within sensitive limits, and the barrier which separates them from man, has no encroachment made upon it by them; but is it equally intact on man's side, is man as great as we have represented him to be, has he not been over-estimated?

2. *The intelligence of savages.*—It would be impossible to deny the wretched condition of the savage tribes. Relegated to some inhospitable corner of the earth, they wander across forests, or by the borders of lakes, seeking by fishing or hunting for that which will satisfy their hunger. Their language is poor, and their social organisation very rudimentary. Intellectual life occupies a very small place in their existence: apparently all their energies are devoted to conquering in the struggle against death.

The theorists, who are our opponents, consider the savage as one who retards the progress of the human family, as midway between the monkey and civilised man. That which is hardly outlined in an animal is already evolved in a savage, and thus presents to us a living testimony of a progressive phase through which humanity has passed. In the same way that a savage would become a civilised man without change of nature, so the anthropoid apes have become savages by a development of the same faculties. Thus the gulf is bridged over which separated man and animals.

[1] Fouillée, *Revue des Deux Mondes*, Origine de l'instinct, October 1886.

This creates an apparent difficulty and has troubled many. Before treating at length the subjects of primitive man and savage tribes, as we shall do in the course of these studies, we must outline the principles which will solve the problem, and do away with the difficulty.

According to our idea the savage does not annihilate the gap as is asserted; however low in the scale he may descend he still retains obvious signs that he belongs to the human family and is separated from the nature of animals.

Go with him to his home—follow him in the chase—go into the hut in which he shelters himself—enter into close relations with him, and you will quickly discover in him intelligence which is quite capable of generalisation, and of forming abstract ideas upon which Europeans so much pride themselves. His language is not composed of simple cries expressing feelings and passions only, but general forms which, it is true, are not numerous,[1] but sufficiently so as to enable ideas to be exchanged with him. Teach him your language, and in a short time you will find him submitting to your educating influence, and he will follow you even into the regions of metaphysics; you might turn him into a man of learning, of commerce or industry—notice his cunning—see the traps he sets, he ensnares all animals, but no animal seizes and enslaves him. He lights fires, he makes clothes for himself, he manufactures instruments for hunting; his

[1] Nevertheless the language of savages is more complicated than is generally supposed. De Quatrefages takes the Tasmanians as an example which Topinard considers "as inferior to the Australians," and whom travellers, Lubbock says, consider to be beings hardly endowed with reason. (*Prehistoric Times*, p. 452). Now the Tasmanians possessed a rich language. Let us state at the outset the testimony upon which all witnesses are agreed, the many languages which these islanders speak. No less than ten or twelve dialects are known to be used by every two hundred individuals taken from various parts of the island. The prisoners, obliged to live in community, taught each other, and at last formed a common language (or langue franque). The Rev. Nixon, bishop of Tasmania, found eight amongst the children who spoke eight languages differing very much in their words. (De Quatrefages, *Hommes fossiles et hommes sauvages*, p. 330.)

arrows surpass what is necessary for use only and become works of art, if he have leisure. It is quite true to say that all that civilised man possesses may be found in him in an imperfect and rudimentary state, even religion and morality.

There is a community of nature between civilised man and the savage differing only in development. Both are removed by the same characteristics from animals, who only possess sensuous feeling.

Let us now look at the history of the savage races. Whether contemporary races are taken, or whether we study the traces left by the early savage races who inhabited Gaul in the Stone Age, we shall arrive equally at this eminently important conclusion: *the savage cannot be considered as a lower step in the human family, but as having degenerated.* We hope to show presently that the existing aboriginal races in Australia; the poor Fuegians of Tierra del Fuego; the unfortunate Maori, are now in an inferior condition to that through which they have passed, that they bear in their language and in their manners the signs of a higher civilisation. In the same way the men of Chelles, Saint Acheul, Moustier, La Madeleine, Cro-magnon, and Menton have left on the French soil traces of a civilisation which, although in some respects rudimentary, was not less human, as shown by the intelligence which produced it.

In whatever way we look at it, we repeat that the savage is a degraded, degenerated man, but still a man in the full force of the term. In the same way the best trained dog, the most instructed ape, the most cunning cat, may in one sense be considered civilised, but they still continue animals pure and simple. Thus the barrier remains intact whether on the one side or on the other, which we recognised as naturally existing between man and animals.

3. *The faculties of the infant.*[1] — Following out these

[1] This subject has been very well treated by M. St-Georges Mivart in many of his works: *Origin of Human Reason*, chap. v.; *Reason and the Infant*, and in his book *Man*, chap. viii., par. 12 of the translation.

principles the evolutionists assert that the infant repeats the transitional phases by means of evolution, which humanity slowly traversed when emerging from his animal environment. As with the animal, the infant is at first only capable of sensation; in proportion as he grows, so he acquires the faculties which characterise man. A simple animal at first, he afterwards gradually becomes man.

The progressive development of the infant is a fact too evident to need insistence, but the explanation given of it by evolutionists is utterly fantastic and prejudiced. That which we shall give in conformity with our theory on sensitive faculties is logical and just.

In order to reproduce a thought, man requires representations, multiplied pictures—fixed and easily recognised—combined pictures: not because the thought consists of this combination of imagery, but because the mind, when elaborating a thought, utilises many pictures as a proof or surety to itself. Now before human intelligence can elaborate a thought with any degree of precision, the senses must have undergone their education, the brain must have developed in fitting measure, its elements must have become stronger and thoroughly differentiated—all this requires time. Sometimes if the child is left without culture, and has no incentive to thought, the length of time may extend itself to five or six years; sometimes if the education has been more active, and the temperament favourable, the first glimmerings of thought may appear at an earlier period. Some precocious children give proof of intelligence from the age of two years and even earlier.

We should not say that intelligence begins or developes itself in the child, but that it is exercised and acquires ideas in proportion as the child grows. The child is born with intelligence, this intelligence acts as soon as there are favourable conditions.

Would it be possible to say that intelligence is in exist-

ence in the same way amongst monkeys, and that nothing is lacking to them but the requisite exercise of it? [1]

Let us try then, before arriving at any hasty conclusion, to discover, by careful observation, the passage from the one state to the other developed by exercise. Our efforts, of course, would be useless. Consequently, it is plain that the infant is not passing through an animal stage in his development, but following a law of development proper to his human nature.[2]

To recapitulate in few words the first part of this paper, we assert that the oppositions brought forward when alleging the identity of nature between man and beasts, are of little force—that our proposition of the real distinction between them has not been shaken, and that consequently it is necessary to invoke a power superior to evolution for the creation of the human soul. Was the human body, which was the first receptacle of the human soul, the direct product of a divine act of creation? This is the second question before us.

[1] Mivart, when speaking of Romanes' assertion that intelligence is equally potent in children as in animals, makes use of the following excellent scholastic distinction:—"Our position is that intellect is really *in esse* in the infant, though it is but *in potentia ad actum*; as the child developes, use would make it active and manifest. In the brute we deny that there are grounds for asserting it to be potentially present in either sense of the term '*in potentia.*' We would not venture dogmatically to affirm that God cannot have given the brutes a truly intellectual nature, but there is no evidence that they do possess it—even the highest of them—in their adult condition. All evidence, as far as it goes, is also against the possibility of such a thing having been brought about even by Omnipotence, since it would seem to involve an objective contradiction." (Mivart, *The Origin of Human Reason*, p. 215.)

[2] The true nature of any organism whatsoever during the process of its formation, although hidden from our eyes at first and for a time, ends by showing itself clearly to us, if we know how to wait for the period of its development. According to this rule it is manifest that the nature of the infant is that of a reasonable being, since, as is seen daily, the commonest and most simple conditions suffice clearly to show that reason most certainly manifests itself in him by evident signs. As we have already noticed, human intelligence is apparent from the most tender age, long before the child is capable of speaking. (Mivart, *Man*, trans. Segond, Paris, Lethielleux, 1895.)

§ 4. *Origin of the Human Body—Arguments used by the Transformists.*

In the sixth representation of the works of the creation, the book of Genesis shows us the Creator in two distinct acts when forming the first man. At first He fashioned his body from the dust of the earth, then He animates it with a vital breath, with a spirit which is life-giving. This spirit, as we have shown, could not be the result of a progressive nature. God made it from nothing by an act of His almighty power. But this body, this "dust," into which He breathed human life, what was it? How had it been fashioned? Two hypotheses are presented—either God fashioned the human organism in all its parts, in arranging, as seemed well to Him, all the inorganic elements; or He chose the most perfect organism then in existence, the result of the lengthened evolution of living matter during the preceding ages, to raise it to the dignity of man. The transformists, who apply the laws of evolution to man, all range themselves on the side of this second hypothesis. Some, holding materialistic views in philosophy, teach that with his body the whole man proceeded from animality. As has been shown, they erred in not distinguishing between the body and the soul. The others with spiritualistic convictions, consider that the dust spoken of in Scripture, might be a previously prepared organism, made certainly in accordance with the divine design by evolution. It is only with these that we are concerned here.[1]

Those Catholics who, following Mivart, have applied the

[1] Father Brucker vigorously opposes this opinion: "Cette interprétation restrictive est-elle acceptable? Non. D'abord parce que le texte si expressif de Moïse dit certainement plus que cela à tout lecteur qui l'aborde sans parti pris. . . Dans le récit qui nous occupe, non seulement (l'Écriture) n'indique en aucune façon qu'il s'agisse d'une action de Dieu *médiate* (mais) elle multiplie comme à dessein les traits qui donnent l'idée d'une intervention directe, spéciale. . . Notre interprétation du verset 7 est singulièrement confirmée par d'autres textes, en bon nombre, où la formation du premier homme est rappelée plus ou moins en détail." (*Questions actuelles d'Écriture Sainte*, pp. 235, 236.)

principles of evolution to the human body, can furnish no satisfactory proofs on a subject which eludes the grasp of human knowledge; they can bring forward no arguments, but such as tend to establish a possibility or probability only. These arguments, which will now be examined, are partly borrowed from the naturalists, who are also evolutionists, and partly come from reasons of expediency of no great importance.

In company with Darwin, the transformists point to the similarity of the organic form between man and the higher animals, the absence of any tangible gap between man's

FIGS. 73, 74.—Comparison of the leg of man and of a monkey; foot and hand.

organism and the monkey's, the facts of human embryology, rudimentary organs, and ancestral phenomena.[1]

The organic resemblance between man and the higher animals is not disputed. Long before the birth of transformism it was universally admitted that man possesses no special organ which is not also found among the mammalia; even his brain cannot be distinguished by its shape, but only by its development, from that of the monkey. The spiritualist philosophers have never sought in the human body for a sufficient reason for the true distinction which exists between man and animals: they have always frankly acknowledged

[1] E. Perrier, *Le transformisme*, chap. iii. Paris, 1888.

that in his organic parts and vital functions man is a simple mammalian animal.

If the organs are the same, they nevertheless present differences of adaptation and development in accordance with the exigencies of the human species. Thus the structure suited to the upright position, the anatomical difference between the hands and the feet (Figs. 73 and 74), the position of the hair, the shape of the nose, the development of the brain, the form and juncture of the bones of the skull (Figs. 75 and 76), are so many distinctive traits which have led the naturalist to place all the human races in one class; it is the only species of its genus, and this genus the only one of its family; the bimanous family is only connected

FIGS. 75, 76.—Skulls of man and of an orang.

with the quadrumanous in the order of primates. Darwin sought to lessen the importance of these distinctive traits by showing that "each one of them taken separately can be found in a certain number of the higher animals," and is lacking in a certain number of men belonging to the inferior races. The following is an example of his method. Amongst the monkeys, he says, the extremities do not necessarily resemble each other; the difference, it is true, is never carried to such an extent as with man, but it exists in certain cases; sometimes, as with man, the lower limbs tend to become feet; sometimes, contrary to what is found in man, the thumb of the upper member ceases to be opposable. With man, on the contrary, there is a tendency of the great toe to become opposable; this is chiefly seen in the human embryo, but it only persists amongst

certain savages. In spite of his efforts, as will be shown, Darwin did not succeed in clearly establishing the *organic gradation* which he sought between man and animals.

During the period of *embryonic development*, man follows the same successive stages of development as those exhibited by the higher animals. Like them, he passes through certain phases when he bears traces of resemblance to a state of body which is permanent amongst certain of the lower animals. Does he not repeat in brief the various stages through which the species passed before arriving at its present perfection? Certain organs are only temporarily developed, and entirely disappear before the end of the embryonic life, whilst they are permanent in very inferior classes; of this kind are the glands, called "corpora Wolffiana," which correspond with, and act like, the kidneys of mature fishes; the second aortic branch, which disappears at a very early period, but is persistent in reptiles; the fine wool-like hair, or so-called lanugo, with which the human embryo during the sixth month is thickly covered,—except the palms of the hands and the soles of the feet,—and is the rudimental representative of the first permanent coat of hair in certain mammalia. Thus the connection is shown between the human body, and the organism of animals.

It is even more apparent in *rudimentary organs*. These imperfect organs, which are numerous in man, are absolutely inactive; they represent organs which in certain animals play an active part. Are they not perhaps the signature of the common ancestor placed on all his descendants, man and animal? Such organs may have become atrophied in the branch from which the human species sprang, whereas they became developed in other branches issuing from the same trunk. Darwin cites, as examples, the movable muscle of the outer ear, the rudiments of the nictitating membrane, so well developed in the eyes of birds, the position of the hair, the arrangement of certain bones, etc. . . .

In anomalies and monstrosities of the human body we also seek for traces of the animal ancestor. It is well known that *atavism* is a natural law, by virtue of which a living being tends to reproduce the characteristics of his forefathers. This phenomenon of heredity is sometimes shown in a capricious manner; thus an exceptional trait in the parent might be transmitted to the children for several consecutive generations; then it would perhaps disappear for as long a time, to reappear again unexpectedly in isolated cases. In the same way the unexpected characteristics which spring up suddenly in children are inherited from some ancestor whom they possess, and by whom it is possible—thanks to the fact of atavism—to reconstruct the history of a family or species. Now the human organism is subject to striking variations and deteriorations, and these anomalies do not show themselves without a certain amount of order. In fact they approach generally to some lower type, more often to that of monkeys. When an important trait of deterioration occurs, it is often accompanied by others of the same kind. According to Carl Vogt, the microcephalous idiots have, at the same time, marked eyebrows, low, receding brows, and prominent jaws. Apparently, as de Quatrefages thinks, these anomalies show indications of monstrosities rather than real instances of atavism.

Struck by these facts which we have just considered, many catholic authors have been led to think it quite possible that the human body may have been formed by evolution. The Bible record did not seem to them so explicitly expressed as to exclude this opinion; it would still be God who had created man's body, by the action of natural laws in bringing it out of the inorganic world, whether from inanimate dust or from the animated condition, it would in either case be the "dust of the earth."[1]

[1] Voici à ce sujet quelques déclarations qu'il importe de recueillir. "Je ne me permettrais pas de censurer l'opinion du théologien anglais Mivart aussi longtemps qu'elle sera respectée, ou du moins tolérée par l'Église, seul

In this hypothesis there would be a certain grandeur in considering the human body, which is the most perfect of organisations, as the terminal shoot produced by the evolution of living beings, the final result intended by the Creator to furnish an intelligent master of all nature. The physical relations of man with regard to the rest of nature are most readily comprehended—all creation is seen to make one harmonious whole; those millions of species which disappeared before man's arrival would have a "raison d'être,"

juge compétent pour déterminer et qualifier les propositions théologico-dogmatiques, et décider si elles sont en harmonie ou en désaccord avec la Sainte Ecriture." (Card. Gonzalès, *La Biblia y la Ciencia*, t. i. p. 542.) Le R. P. Dierckx, citant les paroles de l'éminent cardinal théologien, déclare "qu'il s'honore de partager les sentiments du cardinal Gonzalès." (*Revue des Questions scientifiques*, juillet 1894.) Le chanoine Duilhé de Saint-Projet, après avoir affirmé ses préférences pour la "doctrine traditionnelle touchant la formation immédiate du corps de l'homme," ajoute : "Mais, en notre âme et conscience, nous ne croyons pas avoir le droit de l'imposer dès à présent comme une certitude de foi divine. Nous ne nous permettons pas de qualifier d'aucune note défavorable l'opinion contraire. Nous ne croyons pas pouvoir dire aux catholiques cherchant la vérité de bonne foi : "Vous n'êtes pas libres de penser autrement, vous n'êtes pas libres de chercher." (*Apologie scientifique*, p. 372, note.) Au Congrès catholique de 1894, le même auteur faisait nettement la même déclaration. (*Comptes rendus, section d'anthropologie*, p. 10.) Au Congrès catholique de Paris, en 1891, Mgr. d'Hulst disait : "L'orthodoxie rigoureuse n'impose d'autres limites aux hypothèses transformistes, que le dogme de la création immédiate de chaque âme humaine par Dieu : hors de là, s'il y a des témérités dans ces hypothèses, c'est par des arguments scientifiques qu'il faut les combattre." (*Comptes rendus*, 1891, *section d'anthropologie*, p. 213.) Le livre du P. Leroy a été, non pas mis à l'*Index*, comme quelques auteurs le disent faussement, mais improuvé au point d'être désavoué publiquement par l'auteur et retiré du commerce. Mais il résulte d'une correspondance qui nous a été communiquée, que l'ouvrage avait été suspect parce que l'auteur n'y enseignait pas assez formellement la création immédiate de l'âme humaine. Le P. Zahm, *L'Evolution et le dogme*, t. ii. p. 233, prétend que "l'origine du corps d'Adam par dérivation est une conception qui s'harmonise avec les principes énoncés par le grand évêque d'Hippone et l'Ange de l'Ecole." Voici le passage de S. Thomas le plus significatif : "Augustinus enim vult, in ipso creationis principio, quasdam res per species suas distinctas fuisse in natura propria, ut elementa, corpora cœlestia et substantias spirituales alia vero in rationibus seminalibus tantum, ut animalia, plantas et *homines*, quæ omnia postmodum in naturis propriis producta sunt." (*Sentent*, lib. ii. dist. 12ª, quæst. 1ª, art. 2.)

if they are considered as the component parts of a mighty tree from the topmost branches of which God would gather the human organism. There still remains doubtless a feeling of repugnance; the organic ancestors not of man, but of the human body, would in that case be animals, animals more or less closely connected with monkeys; but has not St Thomas Aquinas taught us that every human individual, before receiving the present form, underwent phases during which it partook of a vegetal and then an animal nature.[1]

These are some of the reasons of expediency put forth by the authors who believe in the possibility or probability of an animal descent for the human organism. This is entirely hypothetical, and much of this special pleading will lose its force when faced by the weighty reasons waiting to be unfolded in favour of the contrary opinion.

§ 5. *The arguments put forth by Mr Russell Wallace.*[2]

We shall quote in the first place the argument used by R. Wallace, by which he demonstrates the intervention of a superior power in the formation of the human body. These considerations possess a still greater interest for us inasmuch as Wallace is one of the warmest partisans of evolution, and he shares with Darwin the honour of having given a scientific basis to transformism by the theory of natural selection. No doubt Wallace considers the human form to be derived from animals, but in his eyes this body owes all the faculties which characterise it to a divine selection. God intervened directly to give the human form to an organism prepared by evolution.

[1] The following extract shows St Thomas Aquinas' opinion, which was already looked on as classical in the Middle Ages: "Anima igitur vegetabilis, quæ primo inest, cum embryo vivit vità plantæ, corrumpitur, et succedit anima perfectior, quæ est nutritiva et sensitiva simul, et tunc embryo vivit vità animali; hac autem corrupta, succedit anima rationalis ab extrinseco immissa, licet præcedentes fuerint virtute seminis." (*Contra Gentiles*, lib. ii. chap. lxxxix.)

[2] Wallace, *Natural Selection*; *Essays*. See de Quatrefages, *Origine de l'homme*, in the *Revue scientifique*, 23rd August 1890.

Without admitting all the arguments of the learned Englishman we may profit by his conception to show that science itself inclines towards the theory that God had intervened directly in the structure of the human organism.

Wallace starts from the principle that *Natural Selection produces nothing which is hurtful or even useless to the species.* This principle is considered so necessary a part of the transformist theory that, according to Darwin himself, a single case proving the contrary would be sufficient to invalidate it. Natural Selection has in view, before all else, "direct and personal utility," it can only eliminate hurtful or useless characteristics, not preserve them. "Thus," says Wallace, "if we find in man any traits which must have been hurtful to him from their first appearance it would be evident that they were not the results of Natural Selection. The same argument would hold good in the case of the special development of any organ if it were either simply useless or out of proportion as regarded its usefulness. Similar examples would prove that another law or another force than Natural Selection entered into play."

This principle once established, Wallace studied the human organism and marked *those characteristics which proved useful or hurtful to the species which had developed themselves during the process of formation.* We shall borrow some examples from him.

According to Wallace and all the transformist school the present savage represents the condition of primitive man: we shall consider later on the value of this assertion; at present we follow our author. "Now," he says, "the present savage, and consequently primitive man, presents a perfect anatomical identity with civilised man. Thus those organs which with civilised man take such an active functional part, would be comparatively useless in primitive man. The hands so cunning in work of a delicate nature—the larynx so admirably adapted for the varied and complicated sounds necessary for modern music, had in primitive man a per-

fection absolutely useless, these perfections would altogether make an entirety of *latent qualities* which could only be fully utilised at a later period. The same may be said of the brain. The amount of the cerebral substance is in direct correlation to the intellectual phenomena, and this quantity is measured by the cranial capacity. Now in primitive man as in the present savage the cranial capacity is obviously the same (about 1.500^{cc}) and equally removed from that of the monkey (on an average 500^{cc}). There is therefore in the savage and in primitive man an excess of power; an implement which surpasses the requirements of the possessor; a power or source of activity which is not utilised, and which will only be brought into use, in proportion to the march of civilisation. Since the essential characteristic of Natural Selection is to lead each species to an organisation in conformity with its needs, *and which must never surpass them*, it can therefore never produce an organic development only with a view to its future use.

Amongst the prejudicial characteristics Wallace names nudity. Almost universally present in the human body, how could selection have deprived man of so useful a protection as hair?

The conformation of the foot also is disadvantageous to man; it would, it seems, have been useful to primitive man to have the thumb opposable to the other fingers in all four members, as amongst the quadrumana.

In the domain of intellectual faculties almost all the traits are beyond the compass of Natural Selection.

It is possible that selection may have been able to develope ideas of *justice* and *benevolence*, for if they are useless to the individual as opposed to the law of the strongest, they would be eminently useful to the community. But abstract notions of time and space, eternity and infinity, artistic feeling, a mathematical mind, could not be of the slightest service to man in his primitive state.

The origin of the *sense of morality* is not less inexplicable.

The savage attaches a feeling of sanctity to certain actions considered good and moral, as opposed to those which are considered only as useful. Natural Selection could not cause the moral sense to prevail over that which was utilitarian; it cannot make duty to be preferred, or a promise to be kept, rather than the preservation of life.

The origin of *religious feeling,* of which Wallace says nothing, is also mysterious. The generous sacrifices of the martyrs dying in defence of the faith, the renunciations which the religious orders make of those natural inclinations which are legitimate, are certainly not inspired by the desire to conquer in the struggle for life.

The examples quoted are sufficient to establish this theory *that natural selection does not account for the formation of man.* Whilst confining ourselves to the limits of organism, we can say with Wallace it is not the work of nature only.

But although selection may not suffice, *is it therefore absolutely necessary to recur to a superior power?* Yes, says Wallace, and for two reasons: (1) Selection is the only natural means which science seems able to propose to account for the origin of living species, which we now see to be insufficient for man; (2) in the case of man, all seems to have been prepared beforehand for future needs, such as the amplitude of the brain and the perfection of the organism. . . . Now natural powers can only respond to present needs —they are incapable of foresight. Therefore a "directing action must have been exercised on man," and the human body is not the result of a blind selection.

In concluding an analysis of these arguments, let it be noticed that the evolutionary origin of the human body must present very great difficulties even from a transformist point of view, since so ardent an evolutionist as Wallace has alienated himself from those of his school holding that view. These difficulties will appeal even more definitely to us when we have studied the arguments set forth by de Quatrefages.

§ 6. *Argument used by de Quatrefages.*[1]

This argument, the foundations of which we borrow from the eminent Anthropologist of the Museum is an argument *ad hominem.* Provisionally accepting the principles of transformism itself as proved, he arrives at a conclusion definitely opposed to the animal descent of the human organism.

We will suppose that the different human races have come from a common source. Agassiz, it is true, considered that the human races began from many distinct creations: but this opinion has always been rejected amongst Catholics. Vogt asserts that some of the Simian races have given birth to branches of the human species; but in this he separates himself from a great number of evolutionist authors; in fact almost all, amongst them Darwin and Hæckel, believe in the unity of the human race.

Hæckel, to whom Darwin always referred those anxious to be informed concerning the human genealogy, places man at the 22nd step in the long chain which commences at the simple monad. The marsupials, which are amongst the lower mammalia, such as the opossum and kangaroo, begin at the 17th degree of evolution. The prosimiæ, represented to-day by the macacus and loris, mark the 18th; the 19th is found in the catarrhines with tails, such as the cynocephalous (hamadryas), the cercopitheke (guenon), and semnopitheke. The catarrhines without tails or anthropoids, as the orang, gorilla, chimpanzee and the gibbon, form the 20th. From these anthropoids to man the distance is very considerable: in order to lessen it Hæckel created a 21st step with the man-monkey or pithecoid, to whom he refuses articulate language and a consciousness of the ego. Then man appears at the 22nd step.

These preliminaries laid down, we argue in the following manner:—

Two principles have a chief place in the theory of descent.

[1] De Quatrefages, *L'espèce humaine*, ch. xi. See the excellent work of M. le Marquis de Nadaillac: *Le problème de la vie*, ch. vi. and ch. vii.

1st. Every being repeats in its embryonic development the phases through which the species has passed. By this fundamental rule the transformists have been able to test the genealogy of the species. Consequently, when two species follow different courses in their development, one cannot have been derived from the other, the most that could be said is that they might both have come from one source of which they were conjointly repeating the traits.

2nd. When once an organism has been modified in a definite way, it retains traces of it through all subsequent modifications, this is called the *law of permanent characterisation.* This law is indispensable for the relation and characterisation of races, as well as their multiplied analogy. Thus M. Perrier places the Metazoa in five distinct and parallel series, corresponding to the five forms of the primitive larva; the larval form *nauplius* invariably gives birth to arthropods, and it cannot produce a worm, a mollusc, nor a vertebrate. Amongst the higher mammalia, when once a member has developed into a foot or hand, it can never by any subsequent modifications change this characteristic of foot or hand.

Now these two principles lead to the same result, that man has never *directly* descended from any known animal species; that it is necessary to go very far back in the animal successions to find him an ancestor.[1] It still remains to establish this important result, and to examine the consequences with regard to our thesis.

1. *At what distance in the animal succession is the ancestor of man to be found?*—No transformist connects man with any animal species now in existence. It was therefore an error to have asserted that Darwin and his school considered that man was descended from a monkey; the transformist teaching is that man and the monkey descended from a

[1] It is manifest that man, the apes and half apes, cannot be arranged in a single ascending series of which man is the term and culmination. (Mivart, *Man and Apes*, p. 172. 1873.)

common source. According to Hæckel this common ancestor is found in the 20th degree of evolution; present man descended from the pithecoid man; the pithecoid man and the tailless catarrhines, from the race of catarrhines with tails. Thus even according to the evolutionists themselves man is only related to animality at the 20th degree.

But de Quatrefages asserts that evolutionary principles require that the juncture should not be made until the 17th degree, that is to say, at the level at which the marsupials detached themselves from the common trunk of the mammalia.

According to the 1st principle already enunciated, man repeats the phases or conditions through which his species has passed. Now man in the process of development only follows in the common line of descent up to the 17th degree; at the point of separation of the marsupials he follows a line of development peculiar to himself with regard to the viscera, etc. Thus, according to Gratiolet, the temporo-sphenoidal convolutions of the monkey, which form the middle lobe of the brain, appear and are complete before the anterior convolutions which form the frontal lobe; with man, on the contrary, it is the frontal convolutions which are the first to appear. Gratiolet goes so far as to say that the human embryo can always be recognised as that of man; now how could it be recognised if it simply repeated the phases belonging to all the other vertebrate? This remark goes even beyond what we are seeking at this moment. Another learned Naturalist, Welker, has made the same observation with regard to the base of the skull, in man the sphenoidal angle diminishes from his birth, whilst in the monkey it continues to increase.

According to the 2nd principle, two distinct organic types might both be traced to a common ancestor not yet characterised, but they could not descend the one from the other. Now in man and in monkeys the organs correspond exactly with each other, but they are placed according to a widely different plan. Thus in man all is arranged so that he should

walk, all in the monkeys is arranged that they should climb. It is contrary to the principles of transformism to say that a walking animal has descended from one that climbs. In that case it will be necessary to go further back than the Simiæ or even the Prosimiæ, to find a type not characterised as a climber: in this way we arrive at the marsupial type of the kangaroo which occupies the 17th degree of succession.

Before therefore constituting itself as a human organism, our first ancestor must have passed through one degree (the 21st) but more probably four (the 18th, 19th, 20th, 21st) since first becoming detached from the animal source.

2. *The consequences relative to our thesis—The first consequence.*—As it has been shown that several intermediary organic types have preceded the present man, and have served as links in the chain connecting him with the common source; these types, in view of becoming man, should be represented now by types which have characterised and preserved each degree of organisation; how is it that no living branch represents the trunk from which sprang the human species? Can it be said that these intermediate types were imperfect and have therefore disappeared in the struggle for existence? But why did not the ancestors of the anthromorphic monkeys disappear also? Why should the human intermediaries have had less chance of survival than those belonging to the Simians?

The fact remains that no living species represents these lacking intermediaries. Hæckel candidly says that the pithecoid man no longer exists; it must have existed formerly, but it is no longer represented. What is to be done if we wish to find the intermediate links capable of connecting us with the marsupials? It would be a strange aberration of the mind to take the savages as the missing links, since from every point of view, whether from that of organic life, even from that of intelligence, they are men in the true sense of the word. Besides no one has really considered them Pithecoid men; they have only been spoken

of as behind-hand in the human family. We shall see further on in what sense this assertion must be received.

The second consequence.—As soon as human organism becomes attached by one or more links to animals, geology should be able to show us the remains or traces of these our ancestors. As there is a great distance between marsupials or even the catarrhines with tails, and men, and the transformation of species takes a long time to accomplish, these intermediate links must have been living a long time, and should have left numerous traces, as all animals have.

Very numerous truly are the remains of man in the past. But far from strengthening the cause of animal descent, all these facts only serve to overthrow it.[1] In fact, however far we may go in our search for the origin of man, we still find him as man; there seems no proof of this slow and ascending progression of the organism supposed to have emanated from animality. Thus even the most ancient human heads have to all appearance the same shape, the same capacity as our own; even the narrowest skulls, such as those of Denise and Neanderthal, are very far from resembling the Simian skulls and quite equal to some human skulls belonging undoubtedly to modern times. In the same way there is no

[1] With regard to the Dryopithecus, which M. de Mortillet regarded as the precursor of the human race (anthropopithecus), and of which Lartet wrote "that it is the only fossil monkey that has been compared with man," M. Gaudry said before the Academy of Sciences in 1890: "The *Dryopithecus*, to judge from the remains which we possess, is not only very far removed from man, but is also very inferior to many of the present monkeys. As it is the highest among the fossil monkeys, we must recognise the fact, that, up to the present, *palæontology has not furnished us with the intermediary between man and the animals.*"

The discovery made by M. Dubois at Java, 1891, 1892, has not further solved the question of the missing type. The molar teeth, the portion of the skull and the femur, supposing them to belong to the same individual, were at first attributed to the monkey type and named *Pithecanthropus erectus*, then to that of man and called *Homo javanensis primigenius*. This is what Virchow said in 1895: "I cannot admit that in the *Pithecanthropus erectus* traces of the union between the monkey and man have been found."

single human bone but clearly bears the impress of its humanity.[1]

As soon as remains are found of man, so soon do we also find traces of his handicrafts, weapons, implements, drawings, marks of fire, etc. And with the appearance of man we recognise the fact that in body as well as in intelligence he entirely resembles those whom we see in our present races.[2]

The conclusion arrived at by these arguments is that man is the same through all time as through all space, that he possessed his present state of perfection from the first, that in consequence he himself constitutes an isolated type apart from the animal species. Hence our assertion at the commencement, that science itself inclines us to believe that the Creator at the moment in which He resolved to form man fashioned him directly or at least consummated and crowned the organism He was about to vivify by the spiritual soul.

We should make this assertion with greater assurance, if we could shut our eyes to the arguments used by the transformists already enunciated (§ 4). The objections brought forward have not been sufficiently answered. The fact of the rudimentary organs is certainly the most embarrassing. The other facts have much less importance, since there is less difficulty in understanding that God should have fashioned man on a type already realised amongst the higher animals, and that He instituted laws of development for him, analogous to those which governed the evolution of all living beings. It is in vain that the transformists strive to annihilate the interval which separates man from monkeys; even the most favourable cases of atavism would not be sufficient adequately to lessen the difference; since, as de Quatrefages has well said,

[1] Here especially we would direct the reader's attention to M. le Marquis de Nadaillac's excellent work, *Le problème de la vie*, ch. v. et ch. vi., Paris, Masson, 1893, since the numerous facts to be found there would strengthen our assertion.

[2] As this subject will be specially treated towards the end of the book it is not necessary to give it any further development here.

the organic anomalies are now more easily traced to teratology than to atavism.

Whilst asserting most emphatically, and as a scientific thesis, that God is truly the Creator of man, since the human soul must of necessity have come from Him, and not by evolution, we have only confirmed the teaching of the Bible.

If the interpreters of Holy Scripture believe that the Sacred Text teaches, as decisively, that God also fashioned directly the human body, there is nothing in the domain of science opposed to this, or to be set aside on account of it, and we gladly corroborate their opinion.

If the Sacred Text is not considered explicitly to decide the question, scientific reasons are insufficient alone definitely to do so, either on the one side or the other.

In all cases it remains indisputably proven that man is the work of God, and not of nature; this is the sole conclusion which it is important to have established.

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CHAPTER V

THE UNITY OF THE HUMAN SPECIES

§ 1. *The Classification of the Human Races.*

BEFORE starting on the question about to occupy us, or even stating it, it will be necessary briefly to enumerate some of the various ideas concerning the human races.

This will be the best means of showing the likenesses which connect the human races, and the differences which separate them and which we must weigh as we proceed.

This at least can be asserted with no fear of contradiction; all can recognise at once whether a living being belongs to the human family or not; information concerning the colour, the anatomical forms, etc., of any population is within the reach of all.

Many authors have essayed to classify the human races; these classifications differ amongst themselves most noticeably because they do not rest on the same fundamental characteristics. Since there is no one special trait which can be considered to dominate the others, the result is that each is more or less arbitrary and artificial. We will go over the more important of them.

That of *Linnæus* was based on the geographical distribution. Linnæus divides the races into the European, the Asiatic, the American, and the black types. This order is very natural, as Europeans can generally be distinguished by their anatomy from Asiatics. Yet how many different types are there in Europe, in Asia, and in America! . . .

Blumenbach arranges five groups of the human races: he made use chiefly of the colour of the skin, but without

neglecting the other traits. *Duméril* also refrained from considering the skin as his sole guide in the classification: taking note of the rest of the characteristics, he distinguishes five chief groups: Caucasians, Hyperboreans, Mongolians, Negroes, and Americans.

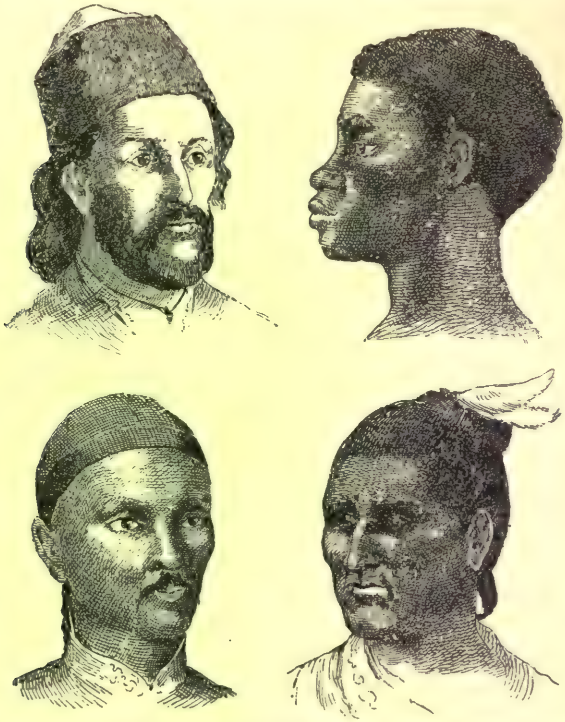
According to *Virey*, the human family is divided into two groups: the first having a facial angle of more than 85°, is composed of a race of white-skinned men, another of yellow skins (Mongolians), and another copper coloured (Americans); the second division has a facial angle of less than 85°, and contains a race with a dark brown complexion (Malays), a black race (Ethiopians), a dark one (Hottentots).

According to *Bory de Saint-Vincent, Geoffroy Saint-Hilaire, Hæckel* and *Huxley*, the classification should be based on the nature of the hair as the most distinctive characteristic. Thus Hæckel divides mankind into two primary groups, those with smooth hair, and those with woolly hair. The smooth-haired are subdivided into straight, such as the Australians, Hyperboreans, Americans, and Malays; and wavy, such as the Dravidians and Mediterraneans. The woolly-haired are also again divided into the tufted growth, and the regularly grown. But in groups thus formed there are found anatomical characteristics, so strikingly different that this classification must be considered artificial. For instance, the Dravidians, who have long heads and dark complexions, have wavy hair, like the Celts who have round heads and clear complexions.

Cuvier based his classification on colour. *De Quatrefages* followed him closely. The great divisions are decided by colour, the smaller ones by other anatomical characteristics. In this way three groups are obtained—the white stock or Caucasian; the yellow stock or Mongolian; the Negro stock or Ethiopian. This classification is open to criticism. Since amongst the negroes some have long skulls, others round ones (negritos); some families with clear skins have been placed in this class on account of other ethnic characteristics. Similarly, amongst the yellow

races are found men with white skins, some have oval faces, others round ones; the eyes are set obliquely with some.

This difficulty of making a natural classification arises from the mixture of characteristics in the different races,



FIGS. 77-80.—Types of the four human races: White, Negro, Yellow, and Redskins.

and the absence of a clearly defined demarcation between them: these facts will be of great service in establishing the thesis that will presently be put forward.

In making known the principal human families, we shall join Dr Verneau[1] in following the classification of de Quatre-

[1] Verneau, *Les races humaines*, Paris, J. B. Baillière.

fages; it is the simplest, and is not more arbitrary than the others (Figs. 77 to 80).

1. *The White or Caucasian stock.*—The white stock comprehends generally those races which have a clear complexion; but owing to the variation of colouring, the complexion is not always of the same light tint. Sometimes the colouring matter is thin and the skin transparent, so that the redness of the blood tinges it; at others the pigment is thicker, and gives a brown tint to the skin; sometimes even, as with the Hindoos, it is so thick that their skin is as black as that of the Ethiopian.

The colour of the eyes is as variable as that of the hair. The hair of the white races is silky, straight, or wavy: it is not woolly as with the Negro, nor wiry as in the yellow races: its transverse section is elliptical.

It is especially by the anatomy of the head that the white race is recognised. The skull is well developed, the forehead wide and high, the arch of the eyebrows is not projecting; the opening of the eyes is horizontal, not oblique, the nose is straight and prominent; the cheek-bones have not an ungraceful height, as in the negro; the jaws are not projecting; the chin does not recede; the lips are not too thick; the facial angle is about 90°.

The white races occupy almost the whole of Europe, the south-west portion of Asia, the north of Africa, and the north-east coast of America; some tribes are met with in the south-east and in the north-east of Asia, and on the north-west coast of America. In taking possession of America the Europeans peopled it with Caucasians.

De Quatrefages divides this white stock into four chief branches — the *Allophyl*, represented in Europe by the Basques; the *Finnic*, represented by the Laps and Dauphinois; the *Semitic*, represented by Hebrews, Arabs, Egyptians, Kabyles, and Tuaregs; the *Aryan*, represented by Hindoos, Greeks, Muscovites, Germans, and Celts.

The white race usually speaks inflected languages. The

most generally received religion amongst them is Monotheism, under the form of Judaism, Mahometanism, and, above all, Christianity.

According to the figures of d'Omalius d'Halloy, the white races form 42 per cent. of the whole population of the globe; and are about 508,000,000 souls.

2. *The Yellow or Mongolian stock.*—The yellow stock comprises those races in which this colour is more clearly indicated. Nevertheless, as with the preceding stock, the tints may undergo many variations; "from white to yellowish brown, or to olive green" (Verneau).

The hair is long, coarse and stiff: a transverse section of it would present a surface almost circular. The beard is black like the hair, but of small quantity.

The Mongolian skull is generally brachycephalic, that is, short when measured anterio-posteriorally. The face is broad, the cheek-bones high, which gives a lozenge shape to the face. The eyes appear to be narrow and obliquely set, this appearance is due to the arrangement of the skin of the upper lid. The nose, less prominent and wider than that of the white man's, is not as flat as with the negroes. The lips are of medium size, the projection of the jaws, when it exists, is less than amongst the blacks.

The yellow races occupy almost the whole of Asia, except in the south-west. In the north-east some tribes of the white men are found among the Mongolians. On the west side, on the borders of Europe, a mixture of the white and yellow population has taken place, particularly in Russia. The races in the north of America and Greenland have issued from the Mongolian tribes, without mentioning the mixed oceanic races and Americans of whom we shall speak presently.

The monosyllabic languages are those in favour amongst the Mongolian races. The chief religions are the Buddhist and Brahmanist. But neither this language nor these ways of worship belong exclusively to this group.

Again, following d'Omalius d'Halloy, it is reckoned that these Mongolian races are 44 per cent. of the whole population of the globe, that is, about 530,000,000 souls.

3. *The Negro or Ethiopian Stock.*—With the exception of a few families of a yellow tint, the negro type "varies from a more or less dark brown to a pure black."

The hair and the beard are black and woolly; the beard is thin, crisp and frizzy. The hair of the head is thicker. Sometimes it grows in separate tufts, with intervening bald patches (Bushmen), sometimes it forms a continuous growth. It presents a transverse elliptical section, very flattened, which makes it easy to roll or manipulate.

The skull is dolichocephalic, that is, long-shaped from the front to the back; the cranial capacity is on an average less than ours. The forehead is narrow and receding, the arch of the eyebrows very prominent, the eyes large and of a dark colour, the nose short and very flat. The thick lips help to exaggerate the already projecting jaws, which gives a receding appearance to the chin.

Negroes occupy the whole of Africa except a portion of the north; the islands near South Africa are also peopled by them; they inhabit Madagascar, with the exception of the centre. They are met with on the small islands near South Asia, in Japan and the Malay archipelago. Australia and Melanesia have no other population.

The agglutinative languages are chiefly used by the negroes. Their religions vary; fetichism is in vogue amongst them.

D'Omalius d'Halloy considers that there are 136,000,000 negroes, that is, 11 per cent. of the whole of humanity; but he wrote at a time when the vast populations in Africa were still unknown, so that the figures are probably far from the truth.

4. *Mixed races.*—Under this name de Quatrefages includes all the races whose characteristics are a mixture of the preceding types. The oceanic races, which extend to Japan and Madagascar, contain about 27,000,000 souls.

The American races, formerly called redskins, which are spread over the surface of America, especially towards the Arctic regions, may be reckoned as 10,000,000 men. Their language resembles the agglutinative variety.

According to d'Omalius d'Halloy's calculations the entire population of the globe is 1,200,000,000 inhabitants, but scholars of a more modern date mention higher numbers; thus Petermann estimated the minimum at 1,397,000,000; Wagner and Behm even go up to 1,436,000,000 in 1883. It is probable that this last number is below the actual amount.

But the exact number of souls is not so important as the proportions of the individuals composing each race, and the density of the population in each type. If the whole of humanity were represented by 100, the white races would be in the proportion of 42, the yellow 44, negroes 11, mixed Oceanic 2, mixed Americans 1.

In the same way let 100 represent the inhabited part of the earth's surface, the area occupied by each race would be as follows—22 for the white, 28 the yellow, 18 for the negroes, 3 for the mixed Oceanic, 29 for the mixed American.

In this way it is easy to judge of the density of each race: thus on the surface occupied by 1 American there would be found 19 negroes, 21 Oceanic, 50 yellow, and 61 white. These figures plainly indicate in what direction the emigration of dense populations should take place.

We have only spoken of the races now actually in existence, since that is sufficient for the end we have in view. We shall see presently what are the characteristics of those races which are extinct. Do those groups of humanity which resemble each other sufficiently to be readily distinguished from animals, but yet which present differences striking enough to oblige them to be placed in distinct divisions, form one single race with many varieties, or many distinct races? This is the question which is about to occupy us.

§ 2. *On what does the question of the Unity of the Human Race rest?*

The question cannot be answered before being stated. It is all the more difficult to make clear, inasmuch as the meaning of the word species has varied. The best way to understand the problem will be to follow the course of its history up to the present time.

It is an important assertion that the unity of origin is correlative with the unity of species; those authors who have written on the subject agree in declaring that unity of species necessarily implies unity of origin, and *vice versâ.* In fact the oldest definition of species was thus conceived. "Those individuals are of the same species who resemble each other anatomically, and are descended from a common ancestor."

Consequently those individuals were placed in the same species who, although possessing many external differences, were known to have descended from a common source: those individuals whose resemblances caused them to be united in the same species were considered to proceed from the same primitive origin.

Up to the seventeenth century the belief in the unity of origin involved the belief in the unity of species of the whole human race. But in 1655 La Peyrère, a Protestant, since converted to Catholicism, put forth the *Pre-adamite theory* and the plurality of the human species; his idea was to establish thereby also the plurality of origin. He considered that there was an essential difference to be found in the narrative of the Bible, between the persons created on the sixth day at the same time as the animals, and Adam, the father of the Jewish race, who was made of the dust of the earth, after the rest of the seventh day. Between the Preadamites and the Adamites or Jews he considered there was a difference of species and a difference of origin.[1]

[1] La Peyrère, *Systema theologicum ex Præadamitarum hypothesi*, 1655.

This opinion, which was afterwards retracted by its author, had few partisans in the seventeenth century, but in the eighteenth it was taken up again and promulgated by atheistic philosophers who applied themselves to the task of finding the Bible at fault. Voltaire was at the head of the movement. "It is only possible," he said, "for those who are blind to doubt that the white men, the negroes, the Albinos, the Hottentots, the Laps, the Chinese, and the Americans are entirely different races."[1]

By the word "races" he meant to convey the idea of species. For his object was to dispute the unity of the origin of the human families: adopting implicitly the definition of Linnæus, "there exist as many separate species as God created types at the first," Voltaire could not overthrow the theory of the unity of origin except by first breaking down that of the unity of species.

In the first half of this century, politics invaded the question, without adding much illumination to the subject. The Americans pursued the slave trade on a large scale. The European powers put great pressure on the Transatlantic government to oblige them to abandon such inhuman proceedings. It was in 1844 that the minister Calhoun in his reply justified the slave trade on the ground that the negroes were not of the same species as the white men. The American minister did but voice the opinion of many learned *polygenists.*

In fact, quite apart from all philosophical and political considerations, certain naturalists taught the plurality of the human species. Virey, Desmoulins, Bory de Saint-Vincent, Gerdy in France, and Morton, Nott, and Gliddon in America were declared partisans of the polygenist theory; at the same time Linnæus, Buffon, Lamarck, Cuvier, Blainville, the two Geoffroy Saint-Hilaire, Müller, and de Humboldt showed themselves as much attached to monogenism.

In all these discussions, unity of species was never separated from unity of origin. The polygenists relying chiefly on the

[1] Voltaire, *Essai sur les mœurs*, Introd. 11.

organic differences which divide the human groups. It seemed impossible to them that types as different as the negro and the white man can have drawn their origin from a common source. "Certainly," said Virey, "if naturalists saw two insects or two quadrupeds so persistently different both in the external form and in their permanent colouring, as the white men and the negroes are, they would not hesitate, in spite of the offspring which is the result of a mixture of the races, to declare them to be two distinct species."

These words show us the state of the question. As de Quatrefages has remarked, it was more especially treated by palæontologists, entomologists, conchologists, etc. . . . Now, these naturalists are accustomed to deal with species having clearly-marked differing characteristics, they are not greatly concerned about the value of these characteristics; and they are apt to occupy themselves with the morphology of the living being to the neglect of its physiology. How often has this system led them to place the male and female, or even two successive states of the same individual, in two distinct families. This has caused the infinite number of species in palæontology and conchology.

De Quatrefages keeps the question to the point, by taking equal account of the external form, as of physiology. The chief physiological element in his eyes was *affiliation*. Consequently he defines a species as "The entire assemblage of individuals who more or less resemble each other, and who can be considered as descending from a single pair by a natural and uninterrupted succession."[1] Here we see the great champion of the monogenists taking the fact of the unity of origin as a sign of the unity of species. Consequently the two questions are correlative.

De Quatrefages' chief opponent was a learned Catholic, Agassiz, of Swiss origin, Professor in the University of Boston. Being an irreconcilable enemy of transformism and of the variability of living forms, he thought to insure the belief in

[1] De Quatrefages, *L'espèce humaine*, chap. iii.

the fixity of the animal and the vegetal types, by asserting the same of the human types.

From his point of view, the human races could not have been formed by natural influences, but were created separately and directly by God. And as there exist as many species as God created at the commencement, the multiplicity of origins involves the multiplicity of species.

De Quatrefages' important labours were the cause of the triumph of the monogenists; and the question might be considered as definitely settled, if evolution had not given an entirely different aspect to it.

In fact all the arguments of the monogenists have their foundation on the reality and fixity of species. Now, the very existence of species is made doubtful by transformism. According to this theory, species are not natural groups, isolated and parallel, capable of being traced back to as many primitive types, each one created separately by God; but varieties, now more or less alienated from each other, but related, although in different degrees, because like the branches of a great tree, they have all sprung from a common source. In this hypothesis, the words *variety*, *race*, *species*, *genus*, etc., are all conventional terms only, being used to show the greater or lesser proximity of the living forms.

This is not the place to discuss the value of transformism. But since it has numerous adherents, since it rests on reason and facts which cannot be summarily dismissed with contempt, since we are anxious to place the question of the human origin on a higher level than any of the systems under discussion, it will be well to take account of the present mental attitude of the learned on this matter.

This will oblige us to separate the subject of origin from that of species: if the question of species need no longer be discussed, that of origin remains. Whether the human family can claim the name of variety, race, or species, in natural history is of little moment, what is of importance is the unity of origin. The question of species has become one of words

merely; as no doubt concerning the nature of man is involved in it; our interest is concentrated on origin, and if men have the same origin, it follows that they have the same nature. In solving the question of unity of origin, we shall at the same time arrive at a decision on the unity of species as understood before transformism interposed.

This change of aspect presents no inconvenience. In fact the question of species has always helped to solve that of origin: with which the ancient monogenists have no reason to be dissatisfied. Nor the Catholic apologists, since the end they propose to themselves is exactly that of establishing unity of origin. Thus the arguments which we shall use are precisely those of the monogenists, only modified by our present point of view.

The question can therefore be clearly stated in the following way: "Do the present human races exhibit such differences as to make it improbable that they proceeded from a single pair?" In solving this proposition we will follow the method of de Quatrefages. We will seek amongst animals and plants for groups which have certainly descended from the same source, and we will compare them with the human families. Whilst making these researches we must acknowledge that the differences between the human races are not so great as amongst the animal and vegetal races, of which there is no doubt that they have come from the same ancestor; and that the physiological resemblances are of the same nature as those which characterised the parental varieties, and that it is easy to explain the formation of the traits, even the most accentuated, which to-day differentiate the human families.

A note of scientific assurance can be attached to the conclusion that will be drawn in the favour of unity of origin, and it will be a source of true gratification to confirm, by scientific researches, a truth which we learnt as a dogma of the Church, and which the Bible teaches us in a definite manner. Even if this conclusion should bring us into disagreement with certain scientific personages, it will not

be the less precious to us. But we are glad to be able to assert, that it is admitted even by those savants whom we opposed with regard to the "origin of man"; since the greater part of the material transformists, in whose sight man is considered but as a more perfect animal, teach that all the human branches are derived from the same animal source.

§ 3. *Of the value of the differences exhibited by the human races.*

All the arguments of the polygenists lead up to the following observation: "There exists too great a difference between the negro and the white man for them to be of the same species, or to have the same origin." Now the truth seems to us to be more clearly expressed by an entirely contrary proposition. "The difficulty of finding characteristic differences amongst the human races is so great, and those differences which are noticed are of such small importance, that it is impossible to look upon them as indicative of distinct species, or to connect them with several primitive sources."

1. *Absence of characteristic differences.*—Let us suppose for a moment that there are several human species, and that each one can be traced back to a distinct single pair, the following would result from it: (1) that the primitive pairs were characterised by marked differences, since if it were admitted that they were absolutely alike, where is the necessity for many species and many origins? (2) That the descendants of these different pairs bear the faithful impression of the distinctions of their ancestors, throughout all the succeeding variations which have appeared in their organisms, as a consequence of the law of heredity and of permanent characterisation. (3) That these distinctions, so well preserved, are the traits by which the species would be separated or distinguished: in the same way as all the races of dogs have a characteristic which distinguishes them from the neighbouring species, and that all the races

of cats have a special trait in common which also distinguishes them from the neighbouring species, and that all pigeons have marks which specify them, etc., thus, if the white men, the negroes and the yellow races, are all supposed to derive their origin from different pairs, they should also be easily recognised by those traits which clearly place them in separate classes.

Now this is exactly what does not occur. As has been already remarked, there is no one single trait by which the human races can be distinguished and classed. De Quatrefages, in spite of his long and learned labours, has declared it to be impossible to make a natural classification of the different races of men. Why is this?

To begin with, it would be necessary to discover a wide separation which nowhere exists. Place together a paper of a very pale blue colour and one of a dark blue, the contrast between the two would be striking, and the separation between the two tints is rendered very evident; but place all the intermediate shades known to Chevreul between these two extremes, and the contrast disappears at once, the gap is annihilated, the gradual passage from the one colour to the other is recognised. In the same way if you bring white men, negroes, the yellow men, and the redskins together, you are struck by the diversity of the four types thus clearly characterised, as Voltaire appeared to be; but bring together a million of men drawn from all climates, place them in a line according to their colouring, and you will pass by imperceptible degrees, from the light complexion of the European living in towns, to the deep black of the African who wanders in tropical regions. Take whatever characteristic you please, whether colour, hair, the facial angle, height, the cephalic test, you will invariably arrive at the following result; the long line containing the men is without a break, but there is always a separation between this line of men, and that on which those individuals are disposed belonging to neighbouring species.

Not only are the men arranged in a line which is uninterrupted, but they are still further mixed by an interchange of characteristics. This fact is even of more importance than the last. We will show in what it consists.

I have supposed that the men have been arranged in a line according to the colour of their skin, but they are found to be mixed and confused if note is taken of their other characteristics: for instance, we should find woolly hair, stiff hair and soft supple hair, intermingled along the whole length of the line formed with reference to colour; we should also find projecting jaws, and the reverse in all parts of the scale. If we rearrange the line with reference to the hair, which Hæckel considers of primary importance, then amongst the smooth hair or waving locks, we should see in their midst men with long heads or round ones, and those with clear complexions or black skins, men of small stature and those of great size, etc. . . . If we repeat the experiments with regard to the other characteristics, the result is always the same; whichever trait is taken as the base of operations would of necessity lead to a mixture of the others.

Now, this could not have been so had the human race descended from differentiated primitive pairs. For these ancestral differences, preserved in the descendants, would have been the means of making fixed lines of demarcation between them. In animal species this is exactly what we find present: if confusion reigns amongst the races, at least all the races of one species possess some trait in common which serves to separate them from other species.

That it is an impossibility to find characteristic differences between human races is patent to all, and has been implicitly admitted by all anthropologists, since all confess that there is no fixed point on which to found a natural classification.

Even supposing that these differences really existed, and were sufficiently marked to furnish a classification, we assert that their importance would not be sufficient to determine the species. In fact if we investigate those which are

brought forward, we shall see that they are less accentuated amongst the human races than amongst the animals, which are known to come from one source.

2. *Colour.*—The colouring of the skin is that which strikes us most quickly and which leaves the deepest impression. The first polygenists depended entirely on the differences of colour when denying the common origin of the human races.

Now the coloration of the skin is, in itself, a physiological fact of small importance, and is produced easily by environment and manner of living; it is neither more general nor more accentuated than amongst animals.

The constituent parts of the skin need to be studied very slightly to enable us to grasp the phenomenon of coloration. The skin is composed of two layers, the dermis and the epidermis. The dermis, although colourless in itself, takes a red tint from the blood vessels passing through it: the epidermis consists of a superficial layer, more or less transparent, and a deep layer or mucous membrane which secretes a pigment. This pigment, which is found between the dermis and the epidermis, is invariably present in all the races; but its tint is very variable. Amongst the white races it is almost devoid of colour; amongst the Asiatics it is yellow, and amongst the negroes very dark. But even in the same race and in the same individuals, according to the manner of life, and the various parts of the body, the colouring matter various in thickness and in tint. Thus when exposed to the open air it thickens and deepens in colour; whereas with people of sedentary habits, and those who are closely shut up, it becomes thinner and is more transparent. This constant variation robs it of its value as a test.

We shall show presently what a valuable aid this variability is in explaining the formation of the races.

But coloration, even if more apparent and less easily explained, would lose much of its force and meaning, if we compare the human race with the animal.

We find, in fact, the same contrast of colour amongst

animals which certainly belong to the same species, and have proceeded from the same primitive pair. Thus "our fowls show the same distinct colours which mark man. The gallic fowls have a white skin; with the cochin-china it approaches yellow; but amongst the dark fowls it is black" (de Quatrefages). Melanism may also appear suddenly in our poultry-yards, and being propagated by heredity, may form a new race. The bovine races are also very variable with regard to colour, the Normandy cows have often black and white spots. If this melanism can appear in one portion only of the skin of an animal, why could it not also appear in certain individuals of the same race? Moreover, amongst dogs and horses, which can respectively be traced back to the same sources, the colour does not vary less than in man.

We can thus understand how Voltaire allowed himself to be misled by the colour of the human race in order to satirise a truth taught by the Christian religion; but it is difficult to understand a scholar making use of the same argument to raise a doubt with regard to the unity of the origin of man.

3. *The hair.*—The villosities of the human body being a part of the skin, and a simple epidermic modification, the correlation between the nature and colour of the hair and the constituent parts of the skin is easily understood. It will therefore be apparent that a classification based on the differences in the hair would be of as little value as one founded on the cutaneous system.

Let us first notice, with de Quatrefages, that the hairy covering on man presents fewer differences than the fur or coats of animals which are classed, with reason, as belonging to one species. For instance, whilst the human hair, in spite of its different aspects, always keeps its nature of hair, the wool of our sheep is replaced in Africa by short stiff bristles. "In America as soon as the sheep of the Madeleine are no longer sheared, the same thing occurs with them; and on the other hand, amongst the high plateaus of the Andes, the wild boars acquire a kind of coarse woolly fleece." If such

variations cause no doubt to exist with regard to the unity of species and of origin amongst animals, why, when the variations are so much less, should there be a doubt as to the unity of the human origin?

Hæckel attached so much importance to the hair test, that he made it the base of a classification of the human races. He has been severely and justly criticised by many learned naturalists, even by those of his own school of thought. "There are many other characteristics as important," says Hovelacque, "and *one* could hardly be accepted alone to the neglect of all the others without lack of method."

Moreover, if the hair test was so clearly defined as to mark the limitation of the races, it would still lack power to furnish specific traits, since it is essentially the same in all the races; the colour and form vary by slight gradations, but the nature of it remains the same. "Whether it be light or dark as amongst Europeans, whether it be fine and woolly as with the negroes, whether it be coarse and stiff as with the yellow races; whether a transverse section be circular as amongst the last named; oval as with the white men, or elliptical as with the negroes, the hair remains hair." It always keeps its structure of hair, and not that of wool.

The facility with which the colour and form of the hair change in the same individual, according to age and surroundings, prevents the naturalists from using so unstable a foundation.

4. *Anatomical characteristics.*—There is no single anatomical difference that has not been invoked in favour of polygenism. All the objections founded on this point can be answered in the same manner, as there is not a single trait belonging especially to one race which cannot also be found in a lesser degree in certain individuals belonging to all the others. Moreover, even if these organic distinctions exclusively characterised the race, they would still be insufficient to mark the species, since they are always less

accentuated than corresponding peculiarities amongst animals in races of the same species. We shall further enforce this principle when taking note of the chief organic differences which distinguish man.

It may well be a matter of surprise that man's *stature* should differ to so great an extent as it does in the human species, since it is possible to find amongst the African Bushmen some who do not exceed 1^m (3 feet 3 inches) in height, and amongst the Patagonians there are some who attain to the height of 1^m92 (6 feet 3 inches). Even the average height differs much between one race and another, for the average of the Bushmen is 1^m37 (about 4 feet 5½ inches), and that of the Patagonians is 1^m72 (about 5 feet 7 inches). But these two averages alone are very instructive. They show the variations of stature between the races at the extremes, viz. the Bushmen and the Patagonians; one also sees that the lowest average, 1^m37 (about 4 feet 5½ inches), is the 0.8 of the highest average 1^m72 (about 5 feet 7 inches). Now amongst the animals which come from the some source, the variations of size are much more noticeable. Thus amongst dogs, the little spaniel is 0^m30 (about 12 inches) in length, whereas the dogs which live in the mountains (the St Bernard) are 1^m33 (about 52 inches); thus the first is only about 0.2 of the second. Some rabbits measure 0^m20 (about 8 inches), others 0^m60 (about 27 inches); the proportion is 0.3. The height of the horse varies from 0^m76 (about 29 inches) to 1^m80 (about 70 inches); the proportion between the two is 0.4. The difference is not less marked between sheep, goats and oxen.

The *Vertebral Column* varies very little in man. At the most, the addition of one vertebra is all that can be asserted, and that is quite exceptional, not being a characteristic of any human family. Still more rare are those individuals in whom the vertebrate bones of the coccyx have become multiplied in such a manner as to form a tail. Lately a photograph has been obtainable of a young Chinese

having a caudal appendage of about 20 centimetres (about 8 inches). These exceptional cases, which bear no reference by atavism to ancestral inheritance, proceed evidently from teratology. In the animal species, the variations in the spinal column are at once important and constant. There exist "races of dogs, goats, sheep, amongst whom the tail is reduced to nothing more than a short coccyx" (de Quatrefages). In the swine of Africa, the vertebræ number forty-four, in the pigs of England fifty-four. Great variations are also seen in the same race.

The constituent parts of *members* are not less persistent in all the human races, if we put aside certain teratological exceptions, such as six fingers on the hand. Although there are savages who can perform prehensile acts with their feet, yet the big toe or thumb has never been really opposable to the other toes or digits in the lower members. On the other hand, what very striking variations there are in the members of certain animal species! Thus, in the dog, the front paws have five well-formed divisions or digits, the hind paws four complete divisions or toes, with a fifth which is rudimentary. This last toe disappears entirely in certain races of small stature, but becomes equal to the others in those of taller stature. It is possible for the pig to become *soliped*, although normally it has a divided hoof; in this case, between the two divisions which had each a hoof, a third digit is developed, and the three are then enclosed in one hoof. (*Cf.* de Quatrefages, *Espèce humaine.*)

The differences presented in the formation of the *head* have no higher significance. It is well known that there are two opposite types of the human head: the *dolichocephali* have a long head when measured from front to back; but the *brachycephali*, on the contrary, have a short and wide skull. But between these two typical shapes there may occur many transitional or mesaticephalic heads.

There also exist many intermediaries between the *prognathous*, or those with projecting jaws, and the *orthognathous*,

or those with flat faces and small maxillary bones. Not only is there an imperceptible transition from one type to the other, but each shape can be found in all the races, so much so that Hæckel declares that the skull cannot furnish characteristics on which to classify the races. The prognathous and dolichocephalic skulls are found amongst many Europeans, but they are also developed very readily in a more or less savage life. On the contrary, the orthognathous skull finds its natural home at first with the offspring of the inferior races, and is evident amongst many individuals.

But even if the shapes of the skulls were so strikingly distinct in all the races, it would not be well to attach too much importance to them, seeing that the variations are not to be compared to those we find amongst animals, and characterise those which without doubt issue from the same source. It would be well if we could here reproduce the chapter, with full text and illustrations, in which de Quatrefages shows out in full relief these differences, in his *Introduction à l'étude des races humaines.* What different appearances the skulls present of the 150 races of pigeons which all came from the same wild pair! How noticeable are the differences between the heads of the *bos triceros,* the ox of La Plata, and the European ox; again, between the greyhound, the King Charles spaniel, and the bull-dog; also between the white-tufted fowl and the Cochin-China breed. No human skulls ever presented such differences.

The *cranial capacity,* which is the measure of the capacity of the brain, furnishes the polygenist with no weightier argument. Even if the average numbers only are taken into consideration, they establish two certain facts: 1st, They are always very far from the averages obtained by measuring the Simian skulls. 2nd, There is very little difference between those of the human races. Thus, whilst the average of the cranial capacity of the highest apes circulates around 450^{cc}, the average capacity of the negroes (Australians, Nubians, Tasmanians, etc.), according to the

figures supplied by Broca, amounts to 1400^{cc} amongst the males, and 1250^{cc} amongst the females; this proves that the gap is very great between the highest apes and the inferior races of men, since there are no intermediate averages making the ascent or descent gradual. Whereas the difference in the human races between the extreme average is small. Broca considers the average capacity of the highest races (Auvergnats, Bretons, Gauls) to be 1600^{cc}, and 1400^{cc} that of the lowest (Negroes, Australians, etc.). If the actual numbers were to be considered instead of the averages, these figures would then lose the small significance they have. For although the brains of negroes are more feeble, yet large and small brains may be found amongst all races and in all countries. Even if the measure of the cranial capacity were the measure of the intellectual faculties, the differences would be insufficient to characterise two distinct species; but when it is remembered that above 1100^{cc}, the size of the brain is no guide to the powers of the intellect; and that at every degree some distinguished intellects are found, or weak faculties, it is still more evident that the brain cannot serve as a specific base for the human race.

Would the *facial angle* prove more satisfactory? The angle thus named is formed by two lines, one going from the base of the nostrils to the opening of the ears, the other from the most prominent point of the forehead to the upper jaw. This angle, suggested by Camper to distinguish the human races, cannot yield any important results; it is also now much ignored since it is of little value in deciding the quality of the brain, and still less in gauging the intellectual qualifications of the individuals. Even if it merited confidence, the facial angle would be powerless to overturn monogenism. It varies in man from 70° to 90° and is generally weaker amongst the negro races than with the white; but here, as in the preceding case, we find a mixture of individuals of all races belonging to every degree. If, at any time, writers on

the subject have appeared to arrive at the conclusion that the facial angle of monkeys approaches that of men, they have trusted to very defective modes of measurement.[1] In fact, they have sometimes compared the angle of a young monkey with that of an adult man; at others they have mistaken the projection of the eyebrow for the frontal prominence.

5. *The disparity of the races from an intellectual and moral point of view.*—That there are certainly superior and inferior races—that there exist great differences amongst many with regard to acquirements, manners, calling, delicacy of feelings—no one would deny. But that it would be possible to infer from these a plurality of species and origin, the facts themselves would forbid.

Take a people, of whatever kind, civilised or savage, and be assured that the individuals which compose it have descended from the same source; then compare all the individuals with each other. There is no nation, not even a town, where all the degrees of intellectuality would not be found. In Paris, for instance, side by side with the members of the Institute, what ignorance and stupidity may not be found amongst persons apparently half savage who people certain cities filled with the working classes and who have lived in poverty and degradation. On the other hand, amongst the lower races, such as the Fuegians, Australians, and Bushmen, many well-developed intellects may be found in their midst, perfectly capable of acquiring the sciences belonging to more intellectual and more enlightened countries.

There is nothing surprising in this. Since the differences noticed are not those of *kind*, but only of *degree* in the development of an identical nature. What do we find amongst civilised folk which may not also be found amongst savages? What mental quality cannot also be found in any race that may be named? All races have an articulate language,

[1] See Topinard's *Anthropology*. Quoted by Vigouroux, *Les Livres saints*, t. iv. p. 73.

handicrafts, works of art, expressions of general and abstract thought, religious worship, a moral law; all are susceptible of education and progress. The men who are the most brutish are capable of being raised to the level of others and of proving their real community of nature.

Moreover, these intellectual and moral characteristics are extremely *mobile* in the degree in which they exist. If they were of kind instead of degree, the degree would remain invariably in the same race; but it is no such thing. Races and peoples are as capable of elevation and degradation as individuals. Nations, formerly very prosperous and endowed with abundant civilisation, are to-day degraded. It has been proved, as we shall presently show, that populations which are at the present time very degraded have had cultivated men as ancestors; but Gallic and Saxon races are far in advance of their forefathers.

Therefore this inequality of the races is an argument of no weight for the plurality of origin; it is not of the essence of their nature and very variable in its degree.

6. *Diversity of language.*—About the middle of this century many polygenists, when in the heat of discussion concerning the unity of species, thought they had found an argument in their favour in the diversity of the human language. It is not possible, they thought, for the children of the same father to speak languages which can by no means be traced back to that of their ancestors. Rénan went so far as to write: "If the planets, whose physical nature appears to be analogous to that of the earth, are peopled with beings organised as we are, it is possible to assert that the history and the language of these planets do not differ more from ours than do the history and the language of the Chinese." [1]

Rénan himself seemed to recognise the weakness of this argument, since he makes the following avowal: "Are we authorized to draw any ethnographical conclusions from the fact that the languages at present spoken on the surface of

[1] *Histoire des langues sémitiques*, Paris, 1855.

the globe can be divided into families totally irreducible, or impossible to trace; or to say, for instance, that the human species first appeared on different spots, or that one appearance has been made, or that there have been many?" Undoubtedly we must say "No" to this question. From the division of the languages into families we must conclude nothing with regard to the divisions of the human species. Philology teaches nothing concerning this."[1]

This is very true. For if the fact of there being languages which cannot be traced to one source, must prove the distinct origin of the people who speak them, then the African negroes have descended from different sources; and yet all anthropologists agree in attributing the same starting-point to them. An argument proves nothing if it proves too much. As philology would divide people with regard to their origin, who cannot be considered as divided, it follows that philology cannot be used as a just test with which to decide the origin of nations.

In order to understand how it is that men, having the same nature, speak languages so different, we must remember that articulate language is essentially conventional. Natural language, or the spontaneous expression of the feelings and passions, is the spontaneous fruit of our nature; and it is approximately the same everywhere; in all climates the expression of joy, or of sorrow, on account of the invariability of its nature is readily recognised. With regard to artificial language, the community of our nature requires that one should exist, even amongst the most degraded nations: but from the very fact of its being conventional, it varies according to the environment, the customs, etc., as with all the other manifestations of human intelligenee.

Facts which concern the community give us the key to the formation and differentiation of languages. A prosperous people enriches its language by the study of literature and

[1] In the *Revue politique et littéraire*, 16th March 1878. Quoted by Vigouroux, *Les Livres saints*, etc., t. iv. p. 96.

science, but with a people who has declined, the language quickly becomes impoverished. The more united the people, the more the language retains its unity; the more a people is broken up, the more the provincial dialects become multiplied. Commercial intercourse serves to unite languages, but isolation tends to differentiate them. Each one brings into the language his own individual modifications: these differences become accentuated in the same measure as separation is the more complete. It is not therefore surprising that the human families, wandering by themselves across primitive forests and on the banks of the ancient rivers, should have created languages as little able to be traced to one root as those in present use.

Might it not be thought that we should at least find traces of a common origin? Might it not be presumed that the essential roots would be found to be the same amongst all the descendants of primitive man? To this question there are three answers. (1) In all probability the language of early man was very poor; the small number of primary roots, even preserved in their entirety, would be difficult to discover. (2) Philology is not in a position to prove that the languages in present use are independent: between the primitive tongues and those now spoken, there existed numerous intermediaries of which there are no traces left, but which must be taken into account in any history of languages. (3) Since it is a fact proved by experience that a nation infallibly loses certain words from its language as it becomes older, and above all as it degenerates, that loss might involve those very roots; thus making it impossible amongst many of the races to trace the common point of departure.

What has been stated of the intellectual and moral inequalities of the races, and of the diversity of languages, may also be said of the conception which the various nations have made of the Deity. The religious spirit may be found in all races, and throughout all time. This common element takes various forms, but these variations in belief are external

accidents and not of an essential nature. There are no races exclusively monotheistic, and others polytheistic. In all races these two conditions of belief may be met with, therefore they cannot be considered as characterising any special one.

From all that has gone before it will be seen that no difference is sufficient to make a real line of demarcation between human races; or, at least, that there is no single difference so great as to prevent all mankind from being classed in the same species, and traced back to the same primitive source.

§ 4. *The Resemblance between the Human Races.*

As it is so difficult to find characteristic differences between man and man, not only to distinguish the species, but also to separate the races, we should have no trouble in finding resemblances and distinctive family likenesses which connect them. Anatomy, physiology, and psychology unite to prove that inasmuch as the human races are distinct from the animal races, so do they resemble each other. The marks which distinguish a man of whatsoever race from an animal, belong in varying degrees no doubt, but very really, to all men at once.

From the *anatomical* point of view nothing can be more explicit than these words of de Quatrefages: "Whether dolichocephalous or brachycephalous, tall or short, orthognathous or prognathous, the Quaternary man is always man in the full acceptation of the word. The more we study the subject the more we feel assured that each bone of the skeleton, from the largest to the smallest, carries in itself, in its form and proportions, a certificate of its origin that it is impossible to mistake." (*Espèce humaine*, p. 220.) It is true that the illustrious anthropologist here compares the Quaternary races with those at present in existence, but his words apply in a still greater degree (and this was in his

mind) to the present races compared with one another, since the anatomical differences are not more accentuated, nor of another nature, in the ancient races than in those of this age.

Physiology brings us to the same result. The organic phenomena, which differ so greatly amongst the neighbouring animal species, are identical in all the human families. The temperature of the body, the average duration of life, the inclinations, the instincts, the voice and the cries of nature, the length of gestation, etc. All these show the close similitudes which characterise beings of the same species and of the same origin, and not those that differ.

Amongst all these physiological traits that of *affiliation* or interfecundity of the races is the most important. It calls for special notice.

Whatever may be the interpretation given to it, it is now an established fact that all the human races are interprolific. For more than three centuries the mixture of races has taken place in all parts of the world, with the same results; marriages between individuals belonging to the most incongruous races have been fruitful. This fecundity is not the result of means analogous to those used in the case of particular animals belonging to different species, it is the natural outcome of spontaneous alliances produced by the true physiological ties which unite all the human races. These alliances are so productive that in 1861 the Californian legislation was obliged to interfere with severe menaces to prevent the amalgamation of the races. Moreover, the offspring of the mixed races are endowed with a constant fecundity. This is proved by the numerous mixed or intermediary races born of these alliances between distinct races. Thus in the last century the Dutch and the Hottentots produced the mixed race of Griquas, which only disappeared on account of enfeebled offspring.

At the present time a mixed race is now in act of formation between Australians and Europeans. Two-thirds of

the population of Mexico are formed by the mixture of Spanish and Indian Americans. In New Zealand a race is appearing of English and Maoris. Very often the mixed races are endowed with a greater fecundity than the pure races; this has been noticed at the Cape by Le Vaillant, in Peru by Hombron, in Greenland by Captain Jouan.

These questions now under consideration are differently interpreted according to whether the exponents are adversaries or partisans of transformism, but the interpretations of both sides prove conclusively the unity of species and of origin.

This is how de Quatrefages, the avowed enemy of evolution, reasons: (1) Man being an animal, from the physiological point of view, must submit to the general laws which govern the kingdom of living creatures, any doctrine which makes man an exception must be considered false. (2) In the study of living forms, whether animal or vegetal, the sign by which different species are known is the existence or non-existence of continuous interfecundity, the morphological characteristics are of very small importance compared with that of affiliation. According to this distinctive mark it might be asserted that those individuals, although morphologically distinct, are of the same species, though of different races, who have fruitful alliances to an indefinite extent; but those individuals are of a different species, in spite of morphological resemblances, who do not contract interalliances, or whose alliances are either unfruitful or of limited fecundity. (3) If this rule be applied to man, it will be seen that the facts of interfecundity cited above prove that the human families consist not of different species but only of races of the same species; and as unity of species includes unity of origin, the human races have descended from a common origin.

In the eyes of a transformist, of whatever shade of opinion, this argument, in order to preserve its value as a proof, must be set forth after another method. De Quatrefages takes the reality and fixity of the living species for granted, which is exactly the point disputed by evolutionists. Moreover,

de Quatrefages considers that between the natural groups classed under the name of species, the physiological law of relation is absolute; but this law seems overthrown by the progress of observation and experimentation; the examples of fecundity between individuals, who have been classed as indistinct species, have frequently recurred; as also examples of non-fecundity in groups of the same species.

Led by these considerations to abandon the reasoning of de Quatrefages, a partisan of the common descent of the races might argue in the following manner: (1) In the vegetal and animal species there exist fruitful alliances only between approximate forms, or between groups so recently detached from the common branch that the divergence has not become accentuated, nor has led to intersterility; but, on the other hand, groups which have been separated for some time, or formed from distinct branches of the living trunk, would be either absolutely sterile amongst themselves, or would be endowed with a very limited interfecundity. (2) Therefore, the wonderful interfecundity which prevails amongst all the human races shows a very close connection, closer than those groups often have which are classed by naturalists under the name of species, and who have been recently detached from a common branch, of which they preserve by heredity all the fundamental characteristics. (3) Intersterility would prevail amongst the human races if they had been formed separately on distinct branches of animality. Moreover, the intersterility which prevails between man and that group of animals nearest to him, proves that if the human organism were to become attached to that of animality, it would ere this have taken upon itself that autonomy which distinguishes and isolates it.

We do not at all make this argument our own. But since the unity of the origin of the human race seems to us of supreme importance, wc endeavour to show that this certitude enters into all the discussions of the present day on the origin of living forms. Even for the transformist

who believes in the animal origin of the human organism, it would be necessary to recognise the fact that all mankind, both those of ancient times and those of the present day, have descended from one primitive couple. For us, who believe that the evolution of animal and vegetal forms does not necessarily involve that of the human organism, how ready should we be to admit the single origin of all men!

We have already drawn attention several times to the identity of nature which marks the *psychological* phenomena in all the human races; in spite of the difference of degree, this similarity is so striking that it is needless to insist further upon it.

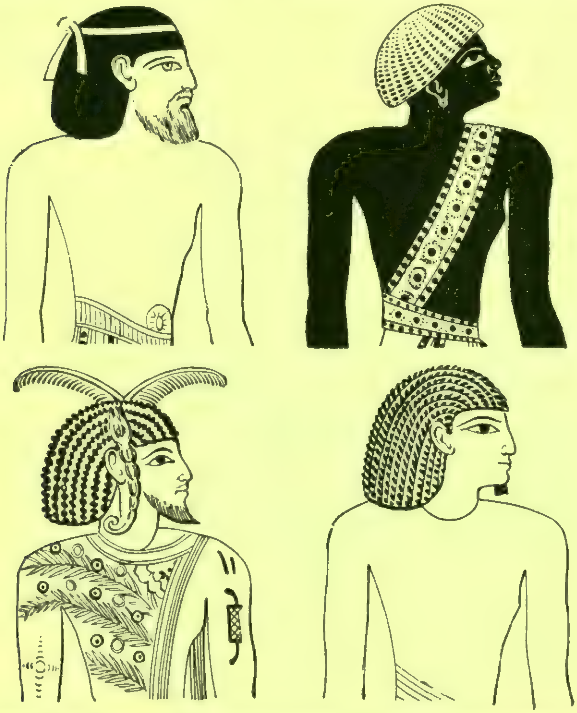
It certainly appears that we have henceforth the right to assert the unity of origin. But it is possible that some religious polygenists might say, resemblance does not necessarily imply the same origin, since God could have created types which resemble each other in different places. Doubtless God could have done this. But the difficulty to be solved is not what it was possible for Him to do, but what He has done; now the Bible and science tell us that all men are descended from the same source. The polygenist, holding the theory of transformism, would say: is not evolution capable of producing the same type in two different branches? Yes, —in the hands of a wise creative intelligence, which is what these same transformists do not desire; no,—if pure chance is to be the agent; no,—even if in accordance with the principles of evolution; since two living branches, when once separated, can only accentuate the divergence.

It remains, to bring our demonstrations to a successful conclusion, for us to prove that scientific monogeny can readily explain the formation of the human races.

§ 5. *On the Formation of the Human Races.*

We must renounce the idea of finding the primitive type, absolutely pure, amongst the present races. For since the

creation of man, the conditions of his environment have changed so many times, and the mixture of races has taken place so freely, that the primitive traits have not been preserved. Some authors, de Quatrefages amongst the number, have striven to reconstruct the physical char-



FIGS. 81-84.—Ancient types, as painted on Egyptian monuments of the 18th dynasty.

acteristics of the first man. Taking the facts of atavism as their base, or rather those organic peculiarities which they attribute to atavism, they admit as probable "que nos ancêtres avaient la chevelure tirant sur la teinte rouge plus ou moins roussâtre," that the yellow pigment was dominant in their skin, that the eye was slightly oblique like those

of the Mongols, and that the upper jaw was somewhat prognathous.

It was at an early period that the human family was divided into many races (Figs. 81 to 84). For the skulls of the Quaternary epoch show marks of differences not less evident than those of the present skulls. The races of Le Moustier, Solutré, La Madeleine and of Cro-Magnon, differed amongst themselves as much as the whites, the yellow races and the negroes do to-day.

It is a very striking fact that the present races are not absolutely identical with the Quaternary or fossil remains. Anthropologists consider present humanity to have been formed from races whose origin is comparatively recent, amongst whom are scattered certain individuals who are connected by their ethnical characteristics with the Quaternary races. Thus in France alone, ethnologists distinguish, in the midst of the various branches of the white Aryan races, certain individuals representative of the Neanderthal man and him of Cro-Magnon.

If the present races are found to be less ancient than was supposed, it may be asked which was the first formed, which has given birth to the others? De Quatrefages[1] strengthening his position by the facts of atavism, considers that the negro race was not the first, and is not the branch from which the other ramifications have sprung: there are numerous facts, such as the complexion and colour of the Bushmen, which lead to the conclusion that they have descended from the yellow races: amongst the yellow and white races there are no traits which point to the negro. Similar reasons lead to the connection of the white with the Mongolian races. Amongst the white races, the Aryan is generally considered to be the last formed.

Whatever may be the relative antiquity of the races, our concern is to ascertain under what influences the ethnical characteristics appeared which differentiate them, such as

[1] *Introduction à l'étude des races humaines*, p. 160, Paris, 1889.

the colour and anatomical changes of shape. Dr Verneau,[1] following in the steps of de Quatrefages, asserts that variations can be produced either by environment, or suddenly and spontaneously, or from the effect of mixture of races. The plasticity of the vegetal and animal organisms under the action of these forces makes it easy to understand the phenomena which are produced in the human races.

1. *The influence of environment.*—Under the name of *environment* we include all the conditions of existence, viz. climate, nourishment, domesticity, or freedom, etc., etc. It is considered natural, when man has not interfered in its arrangement; it is called artificial, when man has established the conditions on a preconceived plan. When the environment is absolutely natural, plants and animals are said to be in a wild condition; in a non-natural environment animals are said to be domesticated or tame, and plants cultivated. Whether in the one case or the other, the living forms infallibly vary with their surroundings.

Everyone knows to what an extent plants vary when placed in different conditions; according to whether they shoot forth in the plains or on the mountains, in a warm climate or under a frosty sky, on the sea-coasts or far inland, plants of a like species present very evident differences: in order to recognise in them the same specific type, it would be necessary to connect the extremes by transitional forms which had grown up in intermediate conditions. By making special surroundings, the florist obtains in his garden the most curious varieties of the same species. He does not act directly on the living object: his power is indirect, since it influences only the surrounding conditions.

The animal organism is not less plastic under the influence of environment. The numberless domestic races fashioned by man, amongst the following species is a proof,—oxen, horses, dogs, pigeons, pigs, etc. . . But nature itself forms

[1] Verneau, *Les races humaines*, Paris, J. B. Baillière. De Quatrefages, *L'espèce humaine; In troduction à l'étude des races humaines.*

races. Thus the foxes of Africa and those of Siberia are of the same species as the foxes of France: the lions of Sennaar are near relations to those of India and Barbary: pigs assume a woolly coat in the cold air of the Cordilleras; the ox loses its hair in the warm plains.

As man is subject to the same biological laws as the other living creatures, he cannot escape from the modifications environment produces. The changes which his organism has undergone are much less important than those brought about in plants and animals by their surroundings, and there can be no doubt that the varying conditions in which he has lived since his creation have fashioned the races with which we are acquainted. But apart from the analogy, we are in possession of facts which enable us to assert definitely the powerful action of environment on man.

De Quatrefages instances the case of those Anglo-Saxons who have hardly been established three centuries in the United States. After the course of about twelve generations the Yankee has ceased to resemble his ancestors. Naturalists have gone into the most minute details of this subject. After the second generation, English-Americans showed a nearer approach to the local races in their characteristics. "The skin becomes dryer and loses its rosy tint; the glandular system is reduced to a minimum; the hair darkens and becomes straight and glossy; the neck more slender; the head diminishes in size. In the face, the depressions under the temples are marked; the cheek-bones are high; the orbital cavities are deep; the lower jaw is massive. The bones of the extremities are elongated at the same time their dimension contracts, so much so, that in France and England gloves are made especially for the United States, the fingers of which are exceptionally long. The pelvis of the woman approaches more nearly that of man" (De Quatrefages). These alterations are certainly very remarkable: and that they are caused by environment is proved by the fact that they tend to bring the English type into greater similarity with the Indian.

Another author demonstrates that on this American continent, whether negro or white men, "all tend towards the Red Indian" (Elisée Reclus).

During the last 150 years the negro also has undergone remarkable changes. His colour is paler. "With regard to his external appearance he has bridged over one quarter of the distance which separated him from the white man. He has lost his characteristic scent; by this one trait it was possible to distinguish an African from an American negro."

When a Frenchman goes to Canada, the same change takes place, the characteristics of the local races are gradually developed, and in this case as in the former one, it is not occasioned by degeneration. Far from it. It is incontrovertible that negroes make progress during their sojourn in America as well from the intellectual as the moral point of view. The Yankee is not inferior to the Anglo-Saxon. The Franco-Canadians form a race possessing great physical strength, capable of sustaining severe bodily fatigue, proud although under foreign rule, and of a wonderful fecundity.

These examples, which could easily be multiplied from other parts of the world, prove that as new races are being formed in this way, so divers races could, similarly, in other times, have formed themselves under the influence of their surroundings. In the cases cited, the differences are no doubt less marked than amongst the older races; but it must be noted that we are engaged with a sub-divided branch and that the divergences are as yet too slight to be very evident; if the fundamental races are, at the present, farther apart, it is owing to the fact of long centuries having accentuated the lesser differences which were originally produced. Let us also remember that we must not expect to see a white man transformed into a negro and *vice versâ.* The white men, the yellow races, and the negroes, are the three extreme points of branches, whose divergence has taken place for some time; each of these branches is capable of producing sub-divisions which ramify again in their turn, at the same time preserving

the fundamental characteristics already acquired by the race. It is an application of the great law of permanent characterisation to the human race.

Thus, although man, more than all other creatures, has the power of avoiding the effects of environment eventually he must submit to its influence. The multiplicity of the races of the human species is as natural as in all other living species.

2. *Spontaneous variations.*—Under the name of spontaneous variations, we understand those organic modifications which appear suddenly, and the cause of which it is difficult to determine. They might at times be classed amongst the "monstrosities" (as Darwin uses the word), sometimes amongst the facts of atavism: they are no doubt due to some deviations which are undergone by the embryo from the beginning of its development.

Dr Verneau mentions the fact of an acacia which was found at Saint Denis in 1805, entirely without thorns, all the stems of the trees grown from the same seeds had thorns, as those had from which they came. Many shoots were taken from the thornless acacia which produced trees of this exceptional type. Should it one day have fruitful seeds, a new race will be formed.

Amongst animals examples are not uncommon. The Mauchamp sheep, remarkable for their silky fleece, owe their origin to an exceptional ancestor whose special traits the breeder carefully preserved by selection. Melanism generally appears spontaneously and may constitute permanent varieties. Thus at Bogota, a black variety of fowl has been produced in a race imported from Europe, and which previously was not found in it. According to Godron, it is not only in New Granada that the black fowl is known, but in the Philippines, Java and Cape Verd Islands, although in other respects the breeds are entirely different; it may also be found in Europe where melanism could only have appeared spontaneously.

Man is not exempt from these sudden modifications. With him as with other living creatures new races may appear, in consequence of the hereditary transmission of traits spontaneously formed. We will quote only two examples, borrowed from Dr Verneau.[1]

In 1817, a person named Edward Lambert, although born of perfectly healthy parents, was entirely covered with a quilled shell, about an inch in thickness. This peculiarity continued during his life time: he was nick-named *the porcupine man.* Married to a woman who was quite exempt from this defect, he nevertheless transmitted this characteristic to his six children and to his two grandchildren. It is not known what has become of the members of this family, but if alliances had taken place amongst them in all probability they would have formed a new race of men with a shell covering.

Numerous instances are given of the spontaneous appearance of additional fingers. In the family of the celebrated arithmetician, Colburn, this anomaly persisted through four generations; although in each generation those with abnormal fingers were always allied with those persons of normal condition, having the usual number. Is it not possible that a strict selection might have resulted in a special race of polydactyl men?

It is not possible to affirm either of the ancient or of the present races that they have been produced by spontaneous varieties; but we must not omit to notice that they form an important factor.

3. *The mixture of races.*—This is the means by which new types are formed from the alliance of individuals belonging to distinct races of the same species. It is extensively practised by breeders, on plants and animals, but is rare in nature in its wild state. The general law is that half-breeds have the characteristic traits of both races: their fecundity is persistent. From these two remarks it may be seen that

[1] Verneau, *Les races humaines*, J. B. Baillière, p. 39.

a mixed alliance fulfils the necessary conditions for the constitution of new races.

Amongst the human races do mixed breeds exist? Are they endowed with great fecundity? Can they be considered as beneficial to the human family?

After de Quatrefages' exhaustive studies on this subject we need not hesitate to answer these questions in the affirmative.

Mixed human races must have existed from very remote times: it is the only explanation of the fact that certain Quaternary races exhibit the types of several races at the same time. As soon as the first human races were formed by means of spontaneous variations and changes of environment, the mixture of races began to take place. Although the human families were much more isolated than at present, contact between them was not altogether lacking. Since navigation has taken Europeans to every shore, the alliances between races have much increased.

Thanks to railways and steamers, inter-communication between countries becomes still easier, and the mixture of races is carried out on a still larger scale.

That alliances between the white races and negroes (that is, between the extremes) are fruitful, is no longer doubted; in the existence of mulattos we have the living proof. But that which has been more often disputed is the fecundity of mixed breeds. It is now acknowledged that they are fruitful, not only in their alliances with the pure races, but also in those contracted between themselves. Amongst many examples we will take those of the Griquas. Born at the Cape, of Dutch and Hottentot origin, they became so numerous as to inspire alarm, they were banished to the country on the other side of the Orange river; there they form a prosperous population, and continue to increase rapidly. On Pitcairn Island, in the Pacific Ocean, a colony of English and Polynesians (Tahitians) have given birth to a mixed race which has multiplied amongst themselves to a

remarkable extent. Moreover, the mulattos are often more fruitful among themselves than are the whites and negroes.

The half-breeds do not imply a state of degeneracy in humanity. They are rather a renewal of the human species. Indeed not only are they distinguished by fecundity, but also by physical strength, a graceful beauty and intellectual power. It is not therefore mixed blood which will cause a decadence of the human species, but physical wretchedness and intellectual and moral perversion. In the course of our studies, we shall see that the history of mankind furnishes us with many examples of progress and decline; work, sobriety and virtue, make the races powerful: indolence, ease, effeminacy, and moral corruption, will cause the downfall of the most powerful nation.[1]

CONCLUSION.

The problem of the unity of the human origin seems now made quite clear. We consider the thesis as scientifically proved, which affirms that all the human races descended from one and the same primitive couple.

We know it already by the explicit teaching of our religious faith,—by the clear statements of the sacred writings. But the nature of modern thought is such that it wishes to see its beliefs confirmed by science. Formerly great minds liked their faith to govern their science, in these days faith finds a more ready entrance into souls when strengthened by science. This mental attitude is regrettable, but we cannot ignore its requirements.

[1] Some authors consider that *heredity* should be counted as a factor in the formation of the human races. Certainly its action is essential, since it is that which preserves the new characteristic in a variety. But it is precisely because no race can be formed without it that we have not added heredity to the list of factors. What we have striven to discover are those agents which cause a variation in a race; since this variation is the real starting point in the fashioning of races. The variation once produced, it becomes fixed, and is transmitted to the descendants by the action of heredity.

In the present case, we fully meet the exigency. In spite of the title of this paper, it is not the unity of species which has been proved but the unity of origin. Our ideas of species are hazy; but those of origin remain clear; moreover, as has already been said, unity of species could only interest us so far as it leads us to unity of origin.

In applying to the human family the biological laws which govern animals and plants, we arrive at the following results: (1) The differences which characterise the human races are less important than those which distinguish the animal and vegetal races, the identity of whose respective origins is certain. (2) Amongst the human groups there exist anatomical, physiological, and psychological resemblances for which unity of origin alone can account. (3) The factors which combine to create animal and vegetal races act also on man, and their action is quite sufficient to explain the fact that one single primitive type has been able to give birth to the divergent races known to us.

The Polygenists have often asserted, in favour of their theory, the impossibility of peopling America and Polynesia with the descendants of a single couple created on the Asiatic continent. But de Quatrefages has clearly demonstrated the fallacy of the objection. At times, by the analysis of the ethnic types, at others by geographical studies, he has shown that America and Polynesia could be, and were populated by Colonies which were detached from Asia at various periods.

Knowing that one man was the father of all humanity, it will be interesting to search out to what period of antiquity we can trace back the creation, and under what intellectual and moral condition man had his beginning.

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CHAPTER VI

THE ANTIQUITY OF MAN

§ 1. *Where shall the Solution of the Problem be sought?*

AT what date did the creation of the first man take place? Although this question is of less importance than that of the origin and unity of the human species, it intensely excites our curiosity. Since it has received in these later times very different solutions, it is interesting to try to discover which most nearly approaches the truth. Whilst some anthropologists trace man's beginning back to more than three hundred thousand years, we consider that the most reliable calculations oscillate between average numbers, which are very much less than the one above named.

But where shall we find proofs worthy of credence relating to the antiquity of man? Perhaps some of our readers may be surprised to hear that it belongs to Natural History to furnish us with matter, at once the most ancient, the most authentic, and the most exact on the subject in hand. A few words will suffice to make this clear.

History, in the true meaning of the word, can only supply us with information which is quite modern and consequently inadequate. It is well known that history, properly so called, does not go far back; amongst the most favoured people, can two thousand years before the Christian Era be clearly traced? We shall return to this point. But from the nature of history it can at the most only go back to the epoch of the formation of that people. Now before the formation of even the most ancient peoples, how many

centuries must have elapsed during the patriarchal life of isolated families?

Monuments have a connection with history. Monuments can give us authoritative dates; but at what distance from the Creation did those magnificent "tyrants" of Egypt and Chaldea live, who caused the great acts of their reign to be inscribed on brick and stone?

Before the days of history we find *popular traditions.* There does not exist a people which has not traditions relating to its commencement. Amongst all the races a sort of Cosmogony may be found recounting the origin of the world generally, and of man in particular.

These traditions must not be treated with contempt: amongst numerous imaginary variations it is possible to trace common conceptions with regard to our origin. It is difficult to sift the gold of truth imbedded as it is in such an abundance of *gangue* or earthy matter, still a truth known in another way, by another method, may be found in it.

But a question of date could hardly find its solution by these means. How could it be decided up to what point the figures were reliable? Were they worthy of credence they could at the most only give the age of a certain people. We find nothing in the different popular traditions which gives us the real age of humanity.

It seems, nevertheless, as though the Bible were an exception. Indeed this sacred book, worthy of all respect, on account of the Divine Spirit Who inspires and directs its composition, seems to fill the gap which everywhere separates the first days of humanity from history; it gives very explicit numbers, according to which man has been created six or eight thousand years.

Nevertheless, all the exegetists agree in asserting that there is no real biblical chronology, that it would not be possible to fix the date of the creation, if dependence were placed on the sacred writings only. Instead of citing here a hundred

testimonies, which can be read in M. Vigouroux's learned work, *Livres saints et la critique rationaliste*,[1] we will notice only the chief reasons which form the basis of this assertion.

The Scriptures nowhere say that *so many* years or centuries separate us from the creation of man; it is only by an addition of the years of the persons mentioned in the Sacred History that the writers on exegesis have made a chronology. Now these numbers differ exceedingly when compared one with another; as many as two hundred have been collected, of which the shortest period mentioned is 3483 years, and the longest 6984, from the creation of man to the birth of Our Lord. Thus, there is a difference of thirty-five centuries between two interpretations of the same document. To take only the two versions possessing the most authority in the Church, the Vulgate, which is the authorised one, and that of the Septuagint, which enjoys great respect, the difference between them would be more than twelve to fifteen centuries. The Church itself authorises no chronology; on the one hand, it declares the Vulgate to be authentic, which gives the number of years as 4004 B.C.; and in the Roman martyrology, the date of Christ's Birth, is said to be 5199 years after the creation of the world. It seems reasonable to conclude that copyists' mistakes have found their way into the transcription of the figures in Genesis; otherwise, how could the variations be explained in the different versions of the same primitive text?

Even in the event of the sacred writer intending to fix the date of the creation, the loss of the exact number written by him would leave us in uncertainty.[2] But according to exegetists of great weight, it is very probable that there exist wide gaps in the genealogical trees of the first patriarchs.[3] This opinion rests on two facts of considerable importance; analogous omissions have been noticed in others of the

[1] See the 3rd vol. of the 3rd edition, Paris, 1891.

[2] *Ibid.* p. 470. "Il est impossible, dans l'état présent du texte, de connaître les véritables chiffres écrits par Moïse."

[3] *Ibid.* p. 475.

sacred books over which it was easy to exercise control; probably a mnemonic reason may account for the number 10 used in the patriarchal genealogies before and after the deluge.[1] Orientals have a well known tendency to suppress intermediate numbers in their genealogical lists. These considerations alone are sufficient to leave the date of the creation of man in uncertainty.

With still greater reason should we arrive at this same conclusion, if, following the most modern exegetists, we consider the first eleven chapters of Genesis as representing venerated popular traditions, with which the inspired author sought to strengthen the dogmatic truths and morals which, under the guidance of the Holy Spirit, he was to inculcate amongst the Hebrew people, and preserve amongst men. In this hypothesis, history, properly so called, being lacking with regard to the pre-historic times, we can hardly look for even approximate dates in the Bible. It is not for us to judge this opinion. But since it is held by certain Catholic exegetists we quote it; it serves to put this conclusion at which M. Vigouroux arrives in a still clearer light.[2]

"One can only repeat to the learned: Establish the antiquity of man and of the primitive races on firm bases and the Bible will not contradict you. The genealogies in the book of Genesis are probably incomplete; they cannot therefore supply certain grounds for chronology. It is not the office of the sacred writings to instruct us directly on the precise dates of the heavens and the earth nor of our first parents. Do they not wish us to understand that they leave such questions to be discussed by men, provided they are kept within the limits of a wise criticism, since the Bible tells us by the mouth of the preacher (Ecclesiasticus): 'The sands of the sea, the drops of rain, and the days of the universe[3] who can count them?'" (Ecclus. i. 2.)

[1] See the 3rd edition, p. 479, Paris, 1891.

[2] *Les Livres saints et la critique rationaliste*, t. iii. 3rd éd. p. 547.

[3] *Sæculum*, Vulgate. Translator's note.

We wish to draw attention to the fact that the position occupied to-day by exegetists has not been attained by a retreating movement forced upon them by the progress of science. Since the seventeenth century the most competent exegetists have said with P. Petau: "There are no means of knowing at what date the creation took place and it would require a special revelation from God to enable us to know. Those therefore err who not only venture to decide it with certainty, but look on others with displeasure who consider that they may add to or detract from the figures."[1]

This rapid glance at the import of the data supplied by the Bible, enables us to assert the following: 1st. That it is necessary to seek outside Revelation for the means of determining the antiquity of man; 2nd. That in this research, faith allows us great latitude. It behoves us to keep within "the limits of a wise criticism."

It remains now to interrogate the *natural sciences.* With regard to those the question must be stated as follows: 1st. At what geological epoch do we find the first trace of the human race? 2nd. How many centuries have elapsed since man left the first traces of his existence? It is unnecessary to state that geology knows not when it has found the first man; the most it can say is which are the most ancient human remains; in speaking of the greatest antiquity which is known, it does not therefore imply that nothing can exceed it. It is also easily understood that this chronology can only be approximate and not of mathematical precision.

In the two questions laid down we must distinguish a relative from an absolute chronology. Relative chronology is that which classes facts in accordance with their order of succession, without concerning itself to declare the real date in a certain unity of time. Absolute chronology gives

[1] Petau, *De doctrina temporum*, l. xi. c. vi. t. ii. *Cf.* Vigouroux, *ibid.* p. 469.

positive dates by means of unities of time; these unities of time, such as hours, days, years, etc., are all supplied by astronomy.

It will perhaps be of service to our readers if we here notice briefly the two kinds of chronology: correct ideas on the subject are necessary for the right understanding of this work.

In relating the history of this planet from the creation to our own day, the times which have elapsed must be divided into three great phases—the nebular, the stellar, and the planetary.

According to a generally accepted theory the earth was first created in a nebulous condition, as was also the rest of the universe. The elements composing it were mixed in a mass of little density, but of immense volume, which filled all space. Innumerable suns by successive separations detached themselves from the primitive mass and now people the sky. Our sun, which appears so large to us only on account of its proximity, was at first a spherical nebulosity, of which the diameter was at least twice as large as that of the orbit of Neptune. This nebula of the second order, during condensation, loses a part of its matter, which isolates itself and becomes a nebula of the third order. The mass destined to form the earth thus became detached from the solar nebula; it took therefore but tardily its individuality in space. But how many centuries had still to elapse before its elements were condensed into a bulk whose diameter was sufficiently small! Evidently the duration of this nebulous phase surpasses all our conceptions: if the thermo-dynamic laws enabled us to apprehend it, it could only be expressed by millions of centuries. But on a point so difficult of adjudication it is better to be slow in making an absolute statement than to use figures which are much too high or much too low.

When once condensed the terrestrial elements were found to have acquired a sufficient heat to make them luminous.

The earth, whose surface presented the appearance of a rolling sea in constant motion, threw into space a light equal to that of the stars, but this stellar brilliancy lasted a short time; in heavenly bodies of a considerable size, such as our sun, the brilliancy lasts for a longer period; in a mass of such small dimensions as the earth, the excessive heat of the surface was quickly spent by radiation. Moreover, the earth cooling on the outside soon became covered with a solid crust, which preserved the heated core from cooling. From thence began the planetary phase of the extinguished star. Although a period of less duration than the former, science would find it difficult to determine the length, and it must certainly be expressed by high figures.

At the commencement of the planetary phase science abandons the domain of hypothesis and enters on that of facts. Geology divides into five long periods the whole of the phenomena accomplished since the incrustation of the terrestrial body. These phenomena are revealed in their order and nature by the two following principles: 1st. Nature's laws are constant in time as well as in space, so that past facts may be judged by the facts accomplished under our own eyes by physical forces; 2nd. The succession of the phenomena is marked by the same order as that of the stratified deposits, even if at times the layers have been disturbed, the geologist can recognise them and re-establish the natural order.

The first period is called *Primitive* or palæozoic (Lyall); it corresponds to the crystalline and azoic formations, that is to say, those without trace of life. Its limits are bounded on the one side by the formation of the earth's crust, and on the other by the creation of life. At first the burning crust did not permit the oceans to remain liquid; the waters were in a state of vapour with much gas above them; the atmosphere was equal to a pressure of 300 atmospheres. The excessive heat was dissipated slowly, the warm oceans became condensed, owing to the strong pressure acting on the surface

which had partially cooled. At last the moment arrived when the temperature of these seas permitted the development of life. It was then that God created the first living protoplasm.

With the first appearance of life the epoch termed *Primary* begins. It is remarkable for its dense and cloudy, though warm, atmosphere enveloping the whole earth. The climate of all latitudes was identical, this was proved by the fact that living creatures of the same species were found in all seas and on all islets. The light of the sun was dimly diffused, having to traverse thick clouds before reaching the surface of the earth. According to geologists, this primary epoch must have had an extremely long duration ; some have even suggested thirty-six millions of years (Dana). This number has seemed excessive to many competent authors. It is certainly undeniable that thousands of years have been required: 1st. To have transformed an atmosphere so dense as it was at first into one sufficiently clear to allow the direct rays of the sun to penetrate; 2nd. Since living beings, at first simple, should have developed into all the groups known to-day, even to reptiles among the vertebrate; 3rd. That the continents, at first mere islets, should have achieved an important extension and consistence.

The *Secondary* era was a period of calm between the great movements of the earth's surface during the Primary and Tertiary epoch. The lightened atmosphere allowed the direct rays of the sun to penetrate to the earth. The equality of the climate disappeared, the terrestrial zones and seasons became differentiated. Plants and animals made noticeable progress. The mammifera and birds were represented by inferior species, but the great reptiles reigned on the dried continents and on the borders of the sea. Dana supposes that this epoch was four times shorter than that preceding it; he considers it to have occupied nine millions of years. We can only repeat here the observations made above.

The *Tertiary* epoch begins with the awakening of internal activity. The surface becomes rugged and forms huge chains of mountains; volcanoes open at the cracks in the disturbed surface, and pour forth eruptions of recent rocks and lava. The climate and the seasons exhibit still further increase of differentiation, and assume more and more the equilibrium which we know. The living creatures of the highest development appear; the dicotyledons amongst the plants, and mammifers of all orders amongst the animals. According to Dana the Tertiary era must have taken about three millions of years.

Since certain authors trace the first man back to the Tertiary era, we must make some subdivisions. At present geologists distinguish four phases in the length of time allotted to the Tertiary period. The first is called *Eocene,* because some of the species at present existing first appeared; it has been marked in the Parisian basin by multiplied variations in the extension of the sea. The second division is called *Oligocene* or Lower Miocene, because it contains more of the now living species; these limits,—at the best very indefinite,—can only be made plain to a geologist. The third, called *Miocene,* is that in which the Abbé Bourgeois maintains that man lived on the borders of the warm lakes of Beauce and Touraine. Finally the fourth, called *Pliocene,* because it has representatives of almost all the living species, it is little marked in France where emersions took place, but more developed in Italy where the sedimentary deposits are still being formed; it is the Pliocene epoch to which the proofs of the existence of Tertiary man relate.

Under the name *Quaternary* the most modern period of geological time is understood. It begins by the extension of the great glaciers and continues to our day. It is divided into two parts, the *Glacial* epoch, at which time the condensation of vapour was so abundant that the glaciers of the mountains became of extraordinary extent, and the rivers deposited alluvium of great thickness in the valleys and

plains; and the *Modern* or recent epoch, during which the external conditions remained to a great extent the same. If compared with the preceding eras, the Quaternary times are short. Taken alone, however, their duration exceeds what we are accustomed to consider the supposed amount. The creation of man must certainly be traced to a time anterior to the modern epoch; we shall see that man was present during all the phases of the Glacial epoch.

This rapid review of the history of the earth cannot be considered a digression from the subject which occupies us. The discoveries of science are so recent that the results, even those which are the least open to discussion, have not become a part of the intellectual heritage of the present generation. Certain figures have the power of frightening our imaginations not yet accustomed to such long periods of time. We require to have the successive parts of the interval clearly pointed out to us for our minds to receive the due impression of length. Moreover, from having accepted the idea of the immensity of time which has elapsed since the creation of the universe, the creation of man appears to be of quite recent date, although we may have to increase the figures which we have hitherto heard quoted. It is not necessary to add that in increasing the number of the centuries between us and the hour of the creation we take nothing from the force of the argument which asserts the necessity of a Creator; it adds strength to those who maintain the magnificence of His Almighty Power.

We now come to the treatment of our problem. In trying to find at what geological epoch the first man appeared, we shall see that the human species was spread over Europe, from the beginning of the glacial times. In trying to fix the date at which the first human remains are met with, we shall not find it necessary either to admit the high numbers of certain anthropologists nor the excessively low ones brought forward by some authors who are not well informed.

§ 2. *Quaternary Man.*[1]

It is a fact accepted by science that man inhabited Europe from the commencement of the Quaternary times.

Simply to state this proposition is not sufficient. Our knowledge of it will be enforced if we make a brief demonstration. That it may be clear we will state the divisions of the Quaternary era; then we shall be able to say in which strata the first incontestable traces of humanity are found.

1. *Divisions of the Quaternary epoch.*—Putting aside the present epoch we will speak only of that period which preceded it and which is characterised by the invasion of ice over a great part of Europe. Of all the continents, Europe and North America only have been thoroughly explored. The divisions which will be given concern Europe: although America presents analogous phases, yet it is difficult to preserve an exact parallelism between the one and the other.

From many researches made through the whole of Europe, it is found that the Quaternary epoch began by an invasion of ice, that it was marked by many progressive and receding oscillations of the glaciers of the mountains, and that it ended by a period of dry cold followed by the appearance of peat bogs.

It is in Germany that the most important explorations were made. The results obtained by sinking vertical shafts in the quaternary beds in the North and South are very instructive. Thus at Potsdam in the North, beneath the surface were found:

1. Erratic or glacial layers, 3^{m} 3 (10 ft. 10 in.).
2. Sand and interglacial gravel, 2^{m} 5 (8 ft. 4 in.).
3. Erratic or glacial layers, 6^{m} 5 (21 ft. 4 in.).
4. Sand and interglacial gravel, 7^{m} 3 (24 ft.).
5. Erratic or glacial layers.

[1] For the further development of this paragraph we refer the reader to the excellent articles published by M. Boule in the *Revue d'anthropologie* 1888, entitled *Essai de paléontologie stratigraphique de l'homme.*

In the southern part of Saxony were found beneath the surface:

1. Erratic or glacial layers (No. 3 of the Potsdam strata).
2. Sand and interglacial gravel (No. 4 of the Potsdam strata).
3. Lower Erratics (No. 5 of the Potsdam strata).
4. Sand with material from the North.

These two tables, confirmed by many other cuttings, enable the geologist to reconstruct the history of the Glacial period in the following manner. Towards the end of the Tertiary epoch, a warm and uniform climate filled the atmosphere with a great abundance of vapours. The mountain summits recently elevated, hastened the condensation of these vapours: they fell in torrents of rain in the plains, where the great work of the grooving and furrowing of the rocks took place, caused by the rush of waters and the overflowing rivers; in the mountainous regions they fell in vast quantities of snow, where enormous glaciers were formed, of which the moraines travelled far, and were deposited in the valleys. Either from the lowering of the temperature, or from the sinking of the condensing summits, the rains and the snows, the erosions and glacial deposits, little by little, lost their intensity, until finally the present condition of equilibrium was reached.

But whilst they lasted, these phenomena did not present a perfect uniformity. The first invasion of ice extended to Russia, Denmark, Germany as far as Saxony, ice descended from the Scandinavian height across the slight depressions of the Baltic and North Seas. Then the glacier receded so far as to permit alluvial deposits to be superimposed on the lower erratic layers even in Northern Germany. This was followed by a return of the ice; which extended to as great a distance as the first time, since traces are found in Saxony where the same limits were attained. But this great glacier in its turn receded towards the north, and for a sufficiently long time to enable thick interglacial alluvia to be formed. Finally the

Scandinavian glacier retraced its steps, but in a less extended area, since no marks of it are to be found in Southern Germany. During a period of dry cold which followed, it retreated finally to Scandinavia. What we have described will be better understood if presented in a tabular form. The Quaternary epoch presents the following phases, beginning with the most recent:

1. Climate cold and dry: final receding of glaciers.
2. Last invasion of glaciers, the least considerable.
3. Interglacial period.
4. Second invasion of glaciers the most important.
5. First interglacial period.
6. First invasion of glaciers at the end of the Pliocene epoch.

Certain authors have considered that the oscillations of the Quaternary glaciers should be connected with those incessantly taking place amongst the present glaciers. This is not correct. No doubt the face of the Quaternary glaciers underwent slight displacements similar to those now observed in the Alps: but these displacements occupy too short a time to explain the long interglacial periods. To explain the enormous recessions of the Quaternary glaciers, during which time important alluvia were deposited, forests became planted and succeeded each other on the moraines of vanished glaciers, and animals of a hot climate established themselves and left numerous traces, we must have recourse to a time of considerable length, far surpassing that which is sufficient for the present glacial oscillations.

We have only spoken of the chronology furnished by the study of the great Scandinavian glacier. But that is sufficient, since the examination of the ancient glaciers, whether in Great Britain, the Alps, the Pyrenees or Auvergne, all lead the student of stratigraphy to a similar result. In every place the fact of the same great glacial invasion has been established (No. 4), followed by an interglacial period (No. 3);

to this succeeded a glacial extension of smaller amount (No. 2), and lastly the period of dry cold operated in effecting the final withdrawal of glaciers (No. 1). Thus in the French Alps the interglacial gap (No. 3) was so prolonged that an alluvial covering of 50 metres (162 feet) was deposited at Thonon.

M. Boule has successfully established the parallel chronology of the different oscillations in all the mountainous countries of Europe. The same cause must have produced the same effect in the same time on countries which are geographically so near to each other. Moreover the identity of the fauna and flora noticed on the ground abandoned by glaciers, during the interglacial periods, does not allow of doubt.

But at such a distance the identity of the succession of phenomena does not enable us to decide definitely the time at which they were produced. For the climatic conditions which prevailed over the whole of Europe might not be the same in America at that epoch. The fauna which existed then in Europe might not resemble that in America; the hippopotamus and cave-bears, which inhabited France and England during the Glacial epochs, live still in Africa.

Nevertheless it is a singular fact that North America experienced a Glacial period as well as Europe, and which presents the same subdivisions as that of Europe.

1. Epoch of river terraces.
2. Epoch of great lakes.
3. Second glacial period, much restricted.
4. Interglacial period; long interval.
5 First glacial period: of great extent.

What adds to the singularity of the fact is, that in America as in Europe, the same chronological relations are noticed between the most ancient proofs of human remains and the geological periods marked by the same phenomena (Boule).

2. *The first human traces.*—It cannot be said that man has left characteristic traces of his presence wherever he has passed. But there are marks by which we may infallibly recognise his existence. First there are his bones, which betray him without any doubt; since, according to de Quatrefages, there is no single human bone which does not carry in itself a certificate of its origin. Then there are the evidences of his handiwork, either in art or by his implements; the chipped flints; the bones fashioned into awls, needles, or harpoons; the necklaces and pendants which were used as ornaments; the drawings of men or animals engraved on the bones of reindeer, stags and horses; the accumulation of the débris from hunting and meals, found in the caves used as his dwellings; the traces of fire on the flakes of flint or the walls of caves; the drawings in ochre on the natural walls of the primitive shelters.

According to the opinion of all the writers on pre-historic times, the most authentic and the most ancient proofs of man's existence are afforded by the flints of the form of those at Chelles. These flint flakes are the shape of a flat almond, they are chipped by blows on each surface and are made into a point more or less fine, thick at the base and in the middle, thinner, and with an edge adapted for cutting, at the extremity. Often, especially at first, the base of the piece of flint was left to enable the hand to seize this heavy instrument more easily.

In 1888, M. Boule asserted in his essay on Human Palæontology that the first human traces were not found until after the great glacial invasion (No 4.) In saying this he follows the English and German writers on glaciers.

For the countries invaded by glaciers, the proof of this remark was evident. The flint implements of Chelles had always been found on the erratic beds of the great glacial extention. They had never been met with in the pre-glacial deposits, nor amongst the moraines of the first invasion of ice. In the regions visited by ice, whether in Germany,

England or Scandinavia, the earliest limit had been reached: man appeared not to have arrived in Europe, until after the retreat of the great glacial formation.

With regard to the extra-glacial valleys, where the human implements are found in the alluvium of the ancient rivers, it is also difficult to decide the chronology. However, M. Boule considers "that Chelles and Saint Acheul are inter-glacial layers," and that this conclusion "agrees best with the present state of science." (Boule, p. 667.)

The anthropologists, and even M. Boule himself, have now abandoned this opinion. The most ancient flints fashioned by man, have been found in the lower Quaternary amongst the Pliocene fauna, by M. d'Ault of Mesnil in the environs of Abbeville, and by MM. Boule and Capitan at Tilloux (Charente-Inférieure.) These ancient alluvia form the transition of the Pliocene to the Quaternary; the geologists considering them as contemporaneous with the glacial invasion. At Tilloux the human remains are mingled with those of *Elephas meridionalis.* At Abbeville the Pliocene specimens are more numerous.[1] It suffices here to state the fact. In the following chapter will be given the climatic conditions in which the Chellian man lived.

But certain anthropologists believe in a much greater antiquity for the human race, some even tracing it as far back as the middle of the Tertiary epoch. We will see what is to be thought of this.

§ 3. *Tertiary Man.*

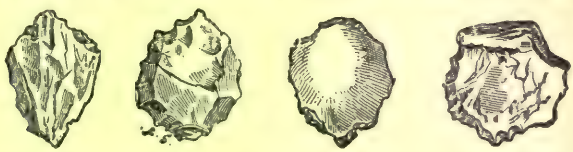
The question of Tertiary man cannot be solved *a priori.* From the point of view of the natural sciences, the arguments and reasons that may be alleged for and against, have about equal weight.

It is certain that the Tertiary epoch offered favourable

[1] See d'Ault du Mesnil, on Abbeville, *Revue de l'école d'Anthropologie*, 15th September 1896, p. 284. For Tilloux, see Capitan in the same review 15th November 1893; Boule, *l'Anthropologie*, 1895, n° 5, p. 497.

surroundings for the human organism; the climate was warmer, and more moist than that experienced at present; the plants and animals the most useful to man covered the face of the earth. Whilst plants and animals have since this period undergone many and great modifications, man has succeeded in preserving his ethnic characteristics intact, thanks to his intellectual powers which have enabled him the better to resist the modifying influences of his environments.

But on the other hand, why should God have created man as soon as the earth was capable of bearing and nourishing him? Doubtless the whole world was peopled by the end of the Glacial period, but it was very thinly populated; it would suffice for the Creation to have taken place in the



FIGS. 85-88.—Flints from Tertiary beds of Thenay (Loir et Cher).

first half of the Quaternary times, for the world to have been peopled during the second half, etc., etc.

We can look only to the facts themselves to solve the problem.

From facts already stated there is a strong presumption against Tertiary man. Since man can be traced by clear and abundant marks throughout the whole of the Quaternary period, why are there only rare signs, which are quite open to dispute, during the preceding epoch, if not because he had not then appeared? If in truth man had lived during the Tertiary times, when his surroundings were so favourable to his increase, is it credible that he should wait so long before leaving indubitable marks of his presence? This argument seems to have a considerable weight. But we will study the facts that are brought forward.

We ought to mention in the first place the flints of *Thenay* (Loir-et-Cher) (Figs. 85 to 88). In 1867 the Abbé *Bourgeois*,

director of Pontlevoy, presented to the International Congress of pre-historic Anthropology and Archæology of Paris, many worked flints found by him in the marl-beds of the Miocene period, at the base of the "Calcaire de Beauce" (Lyall). He thought them to be fashioned by man, most of them showed signs of the action of fire, many were formed into scrapers and awls. The members of the Congress were much divided in their opinions; some considered that these marl-beds had been disturbed subsequently to the Miocene times, others that there were no indications of the flints having been worked by hand, only a few therefore thought that man could be traced to the lower Miocene. These last, including de Quatrefages, consider these flints identical with the implements which the Mincopies, or inhabitants of the Andaman Islands, at present manufacture by the action of fire.

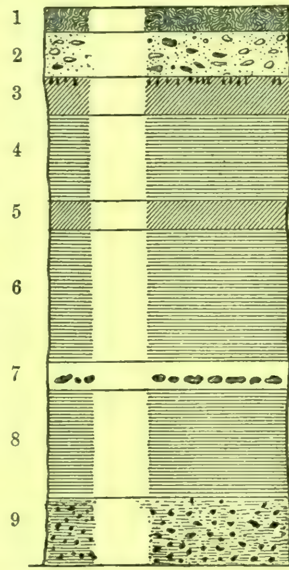


FIG. 89.—Section of a well, dug by the direction of M. Bourgeois on the plateau of Thenay.—1, Vegetable mould; 2, Brick earth with marine fossils; 3, Fresh water chalky deposit; 4, Fresh water white marl; 5, Bed of fresh water calcareous deposit; 6, Marl; 7, Bed of clay, with waterworn nodules of chalk; 8, Marl; 9, Marl, with flints, discovered by M. Bourgeois.

Certain anthropologists have attached so great an importance to Abbé Bourgeois' discovery, that we think it well to examine it somewhat critically. In spite of the doubts of the Abbé Bourgeois, and the further declarations of the Abbé Delaunay,[1] his collaborator, we think that the flinty marl had

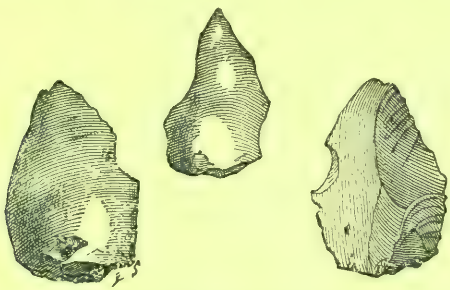
[1] See the letter on the subject written by the Abbé Delaunay to M. Vigouroux, and printed at the end of the 3rd vol. of *Livres Saints et la critique rationaliste*.

been undisturbed. According to geologists, as M. de Lapparent has told us on many occasions, this marl is certainly Miocene. But are the flints the work of man?

Since the traces of man appeared at Thenay, four great geological phases, and four different fauna have succeeded each other in this locality (Fig. 89). After the important gap which M. Douville pointed out between the flinty clay (or marl) and the "calcaire de Beauce," a limitless lake covered the region, and formed solid limestone; then a large river succeeded the lake, and deposited the sands of Orléanais, the sea of Faluns came next, rich in fish, sea molluscs (more than 400 species), polyzoa, bryozoa; on the spot left vacant by the dried up sea carnivorous and herbivorous animals lived, the predecessors of the present fauna. It is evident that such a series of phenomena could only take place during the course of thousands of centuries. What became of man during the length of time which separated the lower Miocene from the interglacial period? If he really lived at Thenay, why did he not people France, and leave indubitable traces of himself?

Moreover, an attentive study of the flints found, leads us to reject their human origin. As: 1. They do not bear the marks of man's handiwork; the bulb of percussion, the systematic blows, the subsequent chipping after the blows, are all lacking in the thousands of pieces found. On the highways, in the masses of small stones split by the sun, can be found specimens which give a stronger impression of intelligent workmanship than is supplied by the flints of Thenay. 2. The cracks or splits do not furnish certain traces of having been caused by the action of fire: the changes wrought in flints by water and variations in the temperature can produce similar effects. 3. It is still easier to account for the notches by the influence of agents which are purely mechanical; in the friction against the rocks, the chipped flints might sustain blows on the edges capable of producing the notched marks. 4. M. Arcelin found similar

chipped flints in the Eocene clay of Mâconnais : now at the Eocene peroid, there would be no question either of man or of Anthropopithecus. 5. Flints are found by thousands in the marl of Thenay: it is not credible that man should have manufactured so many implements, whereas it is quite conceivable that similar conditions should have produced these same effects on so many of the cores of flints. 6. One cannot see of what use these flinty chips could be to man; it has been with difficulty that one or two have been found bearing a resemblance to scrapers and borers; amongst the naturally moulded flints we have often found some which



FIGS. 90-92.—Flints from Tertiary beds found near Lisbon.

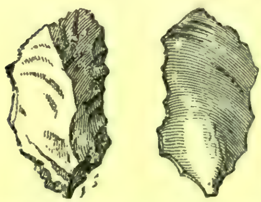
would be of greater use to man than those found by the Abbé Bourgeois. 7. No trace of a human body has ever been discovered in the neighbourhood, to confirm the opinion so open to discussion as the existence of man at this period. Is it not known that the most ancient human bones cannot be traced beyond the middle of the Quaternary?

We may conclude not only that the presence of man in the Miocene times has never been proved but that the contrary seems firmly established: as it is incredible that abundant remains should not have been found in this connection.

A little higher in the upper Miocene at *Otta* (in the valley of the Tagus), Ribeiro (Figs. 90 to 92) thought he had found human traces in the quartz and chipped flints. But as de Quatrefages remarks, the members of the Lisbon Congress

were divided in their opinion of the origin of these flints. In fact everything inspired doubt with regard to these objects; that the fashioning was intentional and not natural, is doubted. They were found *on* the Miocene bed and not *in* it; and as this bed is itself on the surface of a plateau it is not unreasonable to believe that these flints are genuinely Quaternary. How could anyone,—we will not say *establish*, but even *suggest* the theory of Tertiary man?

At Puy-Courny, near Aurillac (Figs. 93 to 94), M. Rames discovered in the upper Miocene some flint flakes which de Quatrefages affirms to have been the result of human work. He fancied that he recognised hatchets, disks, arrowheads, scrapers, short blades, etc. These objects struck from the jadeite and pyromachite could not have been specially selected by the sole agency of natural forces from amongst the numerous varieties of flint abounding in the same bed. But, as M. de Nadaillac observes, it is very strange that the Geological Society of France, first assembled at Aurillac, then at Puy-Courny, could not decide whether the working of the flint was done intentionally, and that several of the members declared it a mistake to consider it to be man's handiwork.[1] It is easy to understand that these flints, tossed by the water, should undergo shocks, capable of detaching several small flakes from the *nucleus.* M. Boule has clearly shown that the separation was only the effect of a gradual erosion. According to M. de Nadaillac, M. Rames only feebly maintains the authenticity of his discoveries.[2] In our opinion the question of the flint of Puy-Courny is not yet definitely decided.

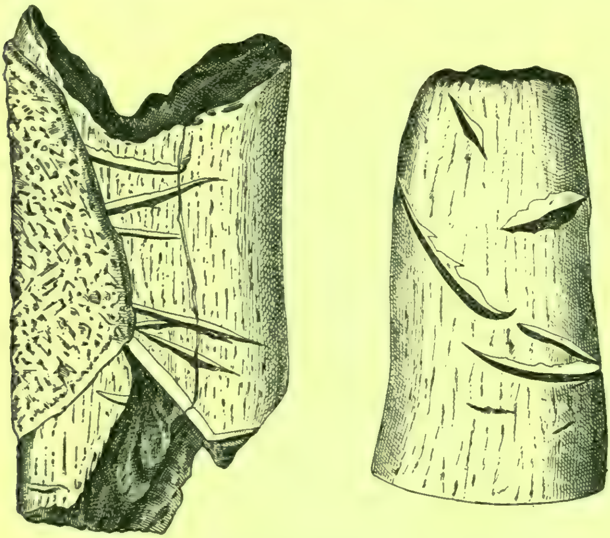


Figs. 93-94. — Flints from Tertiary beds found near Aurillac.

It appeared to de Quatrefages that "the last objections

[1] De Nadaillac, *Le problème de la vie*, p. 191.
[2] *Idem. ibid.*

made to Tertiary man should fall to the ground after an examination, even of a superficial nature, of the incisions on the bones of the Balœnotus found by M. *Capellini*"[1] in the Pliocene clay of Poggiarons near Monte-Aperto (Figs. 95 and 96). M. Capellini considers these marks to have been made by a sharp instrument which was used by man when taking the flesh from the balœnotus as it was lying on the left side in



FIGS. 95, 96.—Pieces of the rib and fore-arm of the *balœnotus*, with several incisions.

the sand. A mammifer or a fish, he says, would have left two marks of the bite corresponding to the two jaws; but a sharp instrument which would chip off a piece of bone, would produce a smooth surface on the side it entered, and a roughened surface on the side from which the chip detached itself. There are, however, many objections that may be raised to the possibility of admitting these marks to be the work of man. There exist fish which are furnished with a single

[1] De Quatrefages, *Introduction à l'étude des races humaines.*

offensive weapon; thus, according to Dr Magitot, blows given by a sword-fish would produce notches on the bones of a whale similar to those noticed by Capellini. In M. de Mortillet's opinion these incisions were made by the carnivorous dog-fish; the same beds contain specimens of its teeth (Fig. 97). The greatest difficulty is that the whale was found at a depth above which there must have been a dozen metres (39 feet) of water in the Pliocene times. The neighbouring hills had hardly emerged (so geologists say) and could not have been inhabited by man.[1]

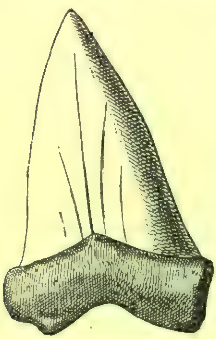


FIG. 97.—Shark's tooth found in the same stratum as the bones. These teeth, according to M. de Mortillet, have made the incisions discovered by Capellini.

Finally we will cite the fact of the skeletons found by M. *Raggazoni* at Castenodolo, near *Brescia*, in a Pliocene bed. The collection of bones belonged to four individuals: a man, an adult woman, and two young children. The skeleton of the woman was almost perfect, the bones were lying together and the parts of the skull in their places. M. Sergi explains the close proximity of the bodies by the fact of the whole family having been wrecked on the Pliocene shore. But the presence of human skeletons in the Pliocene times appeared so astonishing,—as no human remains had been found elsewhere prior to the Quaternary,—that it is thought these layers are probably sepulchres. Since, as M. de Mortillet remarks, if these individuals had been victims of a flood, how was it that the sea did not disperse their remains? Costelfranco also says that this discovery, which was at first proclaimed with so much delight, as were all the others concerning Tertiary man, was abandoned from lack of proof enabling it to be confidently affirmed.[2]

It is useless to examine in detail all the pretended

[1] De Nadaillac *Le problème de la vie.* [2] *Cf. Id. ibid.*

discoveries, which M. Bertrand has reckoned at thirty-three.[1] The discussion would end in each case in the same way; we may therefore state it beforehand.

In science itself there is no trace of Tertiary man, those which have been described as such have probably no existence in reality, there is no proof that man existed before the period of glaciers. At any rate in Europe that was probably the earliest period. Excavations have been made in so many parts that had Tertiary man existed he must have been discovered. How could the remains of man be so clear and so constant from the Glacial period, when there appears no trace of him before that time had he lived then?

Nevertheless we are quite ready to own that our argument is but negative and is not sufficient to form a thesis. From the fact that man had not been discovered before the middle Quaternary we need not necessarily infer that he did not exist. Prehistoric archæology is young, it is making its début; we cannot shut our eyes in advance to the surprises it may have for us.[2]

We have now come to the conclusion that man existed from the beginning of the glacial times, we will therefore try to discover the date to which this lower limit can be traced.

[1] Bertrand, *La Gaule avant les Gaulois.*

[2] M. de Mortillet in his last work, *Formation de la nation française*, asserts that man is necessarily Quaternary. In his opinion there can be no question of Tertiary man; the problem has an *à priori* solution. He gives two reasons: 1. The law of palæontology is opposed to it, for palæontology teaches us that living beings vary and change at each successive stage. As fifteen mammalian fauna have succeeded each other during the Tertiary period, man could not have escaped from this law of change. 2. The Quaternary era is characterised by the presence of man; but this is reasoning in a circle, and is lacking in real weight.

It seems better to keep to facts and to say: The first traces of man are met with in connection with the last traces of *Elephas meridionalis.* Now the disappearance of *Elephas meridionalis* synchronises with the commencement of the Quaternary period. It is generally understood that the Quaternary era begins with the glacial phenomena.

§ 4. *Historical Chronology.*[1]

The historical chronologies will be first consulted. They cannot, as has been said, carry us to the beginning of humanity, but they will help us to fix a limit within which the origin of humanity must be sought. If it can be proved, for instance, that four thousand years before the Christian era certain nations were enjoying full civilisation, this will show us that we must seek for the first appearance of man at a much earlier date.

It will be sufficient to direct our inquiries towards those people whose traditions and monuments indicate a great antiquity. Thus we shall pass over America and Oceania, whose traditions, even if we looked upon them as authentic, would not extend beyond two thousand years. We shall equally pass over the European records in silence; at the most they would only carry us back three thousand years, and it is well known that Asia can furnish chronologies of much greater antiquity.

We shall make a rapid examination of the annals of China, India, Egypt and Chaldæa. With regard to each of these nations, even if their pretensions are much exaggerated, it is impossible to deny them an antiquity which had been little suspected, until these later days.

Evidently the 2,267,000 years, which certain Mandarins adduce as the age of the Celestial Empire, must be relegated to the domain of fables. Even if we accorded to the Chinese traditions a credence which could not be exacted, we should not reach numbers which startle us by their vastness.

According to Sigismond de Fries, one of the most recent historians of China, the history of the Chinese people is divided into two parts: a mythical period and a historical period, which commences 775 B.C. This date he considers

[1] *Cf.* de Nadaillac in the *Correspondant*, 10th and 15th November 1893. A learned article called: les *Dates préhistoriques*. *Cf.* Vigouroux, *Les Livres saints* . . . t. iii.

is the first fixed point from which to start in studying comparative chronology.

It does not necessarily follow that all is fabulous which occurs in the period which this author calls mythical, but no certain date can be affixed to any of the events. This uncertainty proceeds from various causes. Some of the authentic monuments are lacking; the Chinese annals contain many contradictions; and finally, in the year 213 B.C., the founder of the Tsin dynasty caused all books which recorded the lives of his predecessors to be burned. Whether it was preserved, or whether it was rewritten from details supplied by old men, one of these books called Chou-King (the book *par excellence*) gives us particulars of the past in China; but all authors agree in warning us that we must accept its dicta with much reserve.

Even supposing that it merited our confidence, the historical documents found in it only extend from the year 2357 to 627 B.C. If what is called in China *the highest antiquity*, which begins at the reign of Fo-hi, be accepted, we can go back to 2952 according to some authorities, and to 3568 B.C. according to others. These figures, therefore, will point to the fullest limit which we can attain.

China was doubtless inhabited before this period, but Chinese civilisation was not then developed. The inhabitants probably lived much in the savage way as did our ancestors in Gaul during the stone age. They dwelt in caves, used implements of stone, were ignorant of metals, and lived upon raw flesh. These men are called Miao-tzé, or sons of the uncultivated earth. Their descendants still inhabit the mountainous region of China, where they sustained defeat, first by the race of the Pun-ti, then by a yellow race which reigns still in the country. According to M. de Nadaillac, whom we are now following, this invasion of the Mongolian race could not have taken place at an earlier date than twenty-three centuries before the Christian era. This new race quickly attained a high degree

of civilisation, in which condition they have remained. It is well known, thanks to their traditions, that the Chinese learnt at a very early period to note the time of the Solstices and Equinoxes, to amalgamate copper and tin, to coin money, to work in leather and iron, and to weave stuffs.

Among all these uncertainties concerning the Chinese, two things are clear: 1. Thirty or forty centuries before the Christian era, China was already peopled, and the first dispersion of mankind must therefore be placed at a much earlier period: 2. That in allowing a space of 10,000 years, as M. de Nadaillac does, for the extent of man's existence, all the demands which Chinese traditions make of time are amply satisfied, even though hypothetical. Thus, if we suppose that the Miao-tzé have been masters of China for 6000 years, would not 4000 more be sufficient for mankind to have developed and have overspread the whole of Asia?

The past of India is as little known as that of China, and will not oblige us to use higher figures. The millions of years which the Hindoos assign to their country are not less fabulous than those of the Chinese. It is outside the boundary of these myths that we must seek the chronology. The records which are the most worthy of credence do not extend beyond 1000 or 1200 years before the Christian era; according to some authors, no historical chronology can be established until 800 B.C.

The chief monumental and literary records concerning the Hindoos are the following: 1. The tri-lingual inscription discovered at Persepolis, in which Darius, King of Persia, spoke of the territory of Hindu Kusch as having submitted to his dominion. 2. Some fragments of the writings of the Greek author Megasthene, who, about the year 300 B.C., visited India as ambassador of the King Seleucus Nicataor. 3. The Inscriptions of Açoka, made in the year 250 B.C., are the most ancient documents belonging to the country. 4. The

Vedas, a celebrated literary work of the ancient Hindoos; it was composed at different periods, the most ancient extending to 1400 B.C., but it does not instruct us in any historical fact. 5. The old Epopee called *Mahâbhârata*, and the drama *Çacountalâ*, which revealed to the west the rich civilisation of the Hindoos, are apparently still more recent than the Vedas; according to Lassen, the authority on India, the victory which terminates the war recorded in the poem, should be placed between the tenth and eleventh centuries.

Other monuments, such as Megaliths, which are analogous to our Breton Dolmens, are of an uncertain date. Sometimes these Dolmens have stone crosses on them, and certain archæologists tell us that these Dolmens would only have been erected during the first centuries of the Christian era.

But long before the period at which the monuments would lead us to expect, India was inhabited. Flourishing towns existed whose names are entirely forgotten. Many implements, such as knives, arrows, etc., indicate that the stone age, as in Europe, preceded by many long centuries the age of metals.

It is generally admitted that the Aryans must have invaded India at least 2500 years B.C. But before the arrival of the Aryans, the yellow race had already made an irruption in the Indian peninsula; they found negroes of the Ethiopian type, who in their turn had dispersed the negritos, whom de Quatrefages considers to have been the first inhabitants of India.

This statement suffices to prove that India was inhabited during long centuries before its first certain historical dates. However, there is nothing to oblige us indefinitely to multiply these centuries, nor to exceed in the case of India the highest numbers which were applied to China.

To prepare an essay on the Egyptian chronology, we should seek in three sources for the necessary information: the Greek writers, the history of Manetho, and the recently discovered monuments.

There are too many contradictions in the Greek writers, who tell us about Egypt, for us to be able to give them much credence. Plato considered that Egypt had arrived at its full civilisation for 10,000 years (Leges ii.). The priests of Heliopolis declared that their monarchy had existed for 8000 years. At a later date Herodotus learnt, from the priests of the same temple, that annals of their kings could be traced back to more than 11,000 years. Varro allowed 2000 years, and Diodorus of Sicily 5000, as the period of the existence of the Egyptian monarchy.

Three centuries before the Christian era Manetho, an Egyptian priest, was commissioned by Ptolemy Philadelphus, to write the history of his country. This history was burned in the great fire which destroyed the library of Alexandria. But some fragments, preserved by Josephus and Eusebius, have transmitted a chronology to us. It attributes to Egypt a period of 30,000 years before the reign of Alexander. This long period has been divided in the following manner.[1]

1. Reign of the gods . . .	13,900
2. Reign of the heroes . .	1,255
3. Reign of kings . . .	1,817
4. Reign of thirty Memphites .	1,790
5. Reign of ten Thinites . .	350
6. Reign of Manes and heroes .	5,813
7. Reign of thirty dynasties . .	5,000

This medley of gods, Manes, and men caused the chronology of Manetho to be relegated for some time to the domain of fables, but when it was found that modern discoveries confirmed the truth of the record with regard to the thirty dynasties, this last part of the work now inspires more confidence. If the thirty dynasties and the 370 kings who reigned in Egypt between Menes and Alexander the Great alone are considered, it is not possible to decide the date

[1] This table is borrowed from M. Vigouroux *Les Livres Saints*, 3rd ed. t. iii. p. 524. It is arranged according to Eusebius.

with certainty. The figures used by those who have studied the subject vary from 2691 (Wilkinson) to 5702 (Bœckh) B.C. F. Lenormand places the numbers at 5004.

Even if we accept this number as decisive there is nothing disturbing in the antiquity of Egypt. But it would be difficult to pronounce definitely on the point, since the numbers have been arrived at by the addition of the years of each king, as if the dynasties had never been co-existent nor the kings reigning simultaneously, whereas it may be seen by the monuments that many kings reigned together during a certain time. The monuments also apprise us that the duration of the reigns has been sometimes increased by Manetho.

The most authentic literary monuments consist chiefly of lists of royal personages, (at the best incomplete, they number four)—hieroglyphic inscriptions recounting the exploits of the Egyptian kings,—stelæ,—tombs . . . etc. . . . We will not describe them here. It is sufficient for our purpose to state that the most ancient are the tombs of the three first dynasties: thus the original monuments, whilst confirming the declarations of Manetho, do not carry us to a more remote period than the reign of Menes, that is to the maximum date, 5000 B.C.

But what concerns us to note is that at this furthest limit of the history of Egypt the highest condition of civilisation had been attained. The Egyptians already knew how to work mines, cast bronze statues, weave and spin wool, and rear cattle. They possessed advanced scientific knowledge: the British Museum contains a papyrus of the XII. dynasty, on which is found a treatise on land surveying. Their religion, which seems to have been monotheistic, was held in honour from the first dynasty; the statues of 342 high priests descended the one from the other, which Herodotus saw at Heliopolis in the fifth century, take us back evidently to the beginning of the thirty dynasties and the 370 kings.

Whatever may be thought of the condition of the first

man, it is quite evident that a very long period of time must have elapsed since the first dispersion of the human family, and since the arrival of the first inhabitants in the land of Egypt; for a civilisation so advanced as the Egyptians possessed four or five hundred years before the Christian era could not but have been the outcome of a slow social evolution. However, we are quite ready to say with M. de Nadaillac that nothing that could be asserted would make us place the creation of man at a period prior to 10,000, since 4000 years are quite sufficient for the peopling of the globe and the growth of civilisation between the creation and the first Egyptian dynasty.

The Chaldæan and Assyrian monuments are those which give us the most exact figures. Before the middle of this century Chaldæa was only known to us by the history of the Chaldæan priest Berose, who lived in the third century before our era. The antiquity of 466,000 years, which this historian claims for his nation, has never obtained credence, so that Cicero himself treated the pretensions of the Chaldæan as untruthful and outrageous. The cuneiform inscriptions, recently deciphered, have revealed to us the names of many of the kings preceding those monarchs whose history was already known, but they go back for the most part only to six or seven thousand years from us.

We will only mention two of these discoveries. The first relates to Sargon, king of Assyria, and to Naram-Sin, his son, who reigned in the north of Chaldæa about 3750 years before our era. At this period art had made great advances, and governments were well organised: astronomical formulæ and calculations of eclipses found on cylinders attest an amount of scientific knowledge which is truly remarkable. The portraits of these kings are drawn with great skill. The second takes us still further back to the origin of this Chaldæan civilisation from which proceeded apparently all oriental civilisation. There are stelæ, bas-reliefs, statuettes, and inscriptions relating to Our-Nina and E. Anna-Dou, his

grandson, much more ancient than Sargon. According to these tablets Our-Nina wishing to erect a temple, worked at it with his own hands. Bronze was already in use at that time.[1]

It is probable that Our-Sina can be traced back to 4000 years B.C. No document exists on the preceding times possessing any chronological value. But how many centuries must then have elapsed since the first appearance of man, no monument enables us to estimate this even in an approximate degree, whether 4000 years should be added, or even more, we have here no means of deciding.

If we wish to deduce certain conclusions from the facts stated, we can infer: 1. That the pretensions of oriental nations to a great antiquity are but legendary. 2. That the most authentic monuments do not take us back beyond 5000 years before the Christian era. 3. That the arts and sciences, already well developed at these historic dates, cause us to infer that we must go to very remote periods for the beginning of humanity. 4. That man's monuments do not furnish us with data which enable us to ascertain the duration of time previous to history. 5. That if the geological records do not instruct us more definitely, there is nothing to oblige us to accord to humanity a length of existence of more than 10,000 years.

§ 5. *Geological Chronology.*

Geology divides the time which has elapsed since the formation of those deposits in which the first traces of man are found, into two parts. In the first is included the present time, or post-glacial; in the second the glacial epoch, man having made his appearance at the beginning of this epoch.

A few years ago learned writers were very lavish in dealing with the thousands of centuries of man's existence. Hæckel names more than 100,000 years; Burmeister supposed that Egypt was peopled more than 72,000 years ago; Draper

[1] *Cf.* de Nadaillac in the *Correspondant*, 10th November 1893, p. 485.

attributes to European man more than 250,000 years; according to M. Joly certain geologists accord to the human race 100,000 centuries; and G. de Mortillet shows that man's existence reaches to about 240,000 years; 6000 historic years, about 10,000 years between geological eras and historic times, and 222,000 years during the Quaternary period.

These numbers have been built up on such arbitrary and fragile bases, that true science could not tolerate them for long. A tendency has also arisen to diminish considerably the figures of the duration of the human race; this is what the learned American MacGee states in 1892, at the end of the Geological Congress at Washington. It is this which caused W. Upham to say: "The observations made at the present time lead us to think that the end of the Glacial period is more modern than has generally been supposed."

We will briefly go through the proofs of geological chronology which have formed the basis of calculation with regard whether to the duration of the present period, or to the Quaternary period.

1. *The present period.*—According to M. Arcelin a period of from 7000 to 9000 years is generally now allowed either in Europe or America for the post-glacial phase continued to the present day.[1] This number is based on numerous observations made by many geologists: if each observation taken singly presents a hypothetical character, which might inspire doubts, yet the agreements of the results is a fact sufficiently remarkable to compel a feeling of confidence in the methods used.

These methods consist in studying "permanent natural phenomena producing effects which connect them and which can be measured, thus giving standards of comparison," it is thus that de Quatrefages defines natural chronometers. A

[1] Arcelin, *Quelques problèmes relatifs à l'antiquité préhistorique,* the report was read at the Catholic International Congress at Brussels in 1894, and published in the *Revue des questions scientifiques,* in January 1896.

good natural chronometer, in order to estimate the length of the present epoch, must be a geological formation which commenced at the end of the Glacial times and has continued uninterruptedly with a certain regularity, and presents certain definite standards of measurement.

The celebrated English geologist Lyell took for the base of his calculations the erosion caused by the fall of Niagara. When at the commencement of the present epoch the river took its regular course, it flowed over the plateau between Lake Erie and Lake Ontario; the falls were then near Queenstown, about 12 kilometres (39,000 ft. cir.) from where they are at present. These gorges of 12 kilometres have been scooped out very regularly by the action of the waters during the present period. Lyell asserts that the falls receded at about the rate of 30 metres (97 ft.) in a century; thus it would require about 40,000 years to wear away a gorge of 12 kilometres. Other learned men since Lyell have studied the same phenomena; but they considered that the erosion had been more rapid than Lyell acknowledged: thus W. Upham places the amount at 10,000 years only, which figures Gilbert reduces to 7000.[1] In this study of the Falls of Niagara, it is taken for granted that the end of the Glacial period corresponds in America approximately to that in Europe: but as we said this correspondence although very probable cannot be proved.

Other calculations have reached us from America: we will mention them with the same reserve. Thus the Falls of St Anthony on the Mississippi lead us to the conclusion that the post-glacial period is 8000 years. Dr Andrews, as the result of observations of the erosions caused by the waves of Lake Michigan, speaks of 7500. M. Emerson gives 10,000 years as the highest, after an attentive study of the lakes Bonneville and Lahonton. Other calculations have produced much the same results.[2]

In Europe it was proposed that the base of calculation

[1] *Cf.* de Nadaillac, *Le problème de la vie*, p. 213. [2] *Id. ibid.* p. 214.

should be some strange mounds known in Denmark under the name of Kjœkkenmœddings, or shell-mounds, in which were found, mixed together by the inhabitants, shells, remains of fish, birds, and mammifera, implements of stone, sometimes roughly shaped, sometimes skilfully worked. But it has been deemed impossible to use these as definite chronological guides, both because they lack standards of measurement, and because the relative date of the beginning of these mounds is unknown.

It would seem that the study of the skov-mose, or Danish peat-bog, would yield happier results. These peat bogs are found in funnel-shaped cavities, scooped out of Quaternary mud, and they sometimes reach a depth of 10 metres ($32\frac{1}{2}$ feet). As man frequented these skov-moses from the times of the first layer of peat in the funnel, and as he must obviously have left numerous implements and objects devoted to his use, naturally there arose collections or "museums chronologically arranged" (de Quatrefages) where each generation has left traces of his existence and evidences of his social condition. In examining these peat bogs layer by layer, it is possible to reconstruct the history of the ancient Danish population, and to see the successive phases of the age of iron, the age of bronze, and the age of stone. If we knew the average yearly growth of the peat, the skov-moses would make excellent chronometers. But as the authors who write on the growth of the peat use numbers varying from one to ten, it is natural that the result should be disputable. The learned Professor Steenstrup assigned 4000 years as the required period for the formation of the peat bogs; but if any author doubled or trebled this number, we should have no right to contradict him, especially if we take into account the sinking which displaces the horizontal position of the lower beds.[1]

In Switzerland efforts were made to discover the age of the lacustrine habitations by the receding of the lakes. The

[1] *Cf.* de Quatrefages *L'espèce humaine*, chap. xii.

lacustrine dwellings were built on piles driven into mud and soil afterwards covered with water. Now at 3 kilometres (9750 ft.) from the present shores of the Lake of Bienne, near the bridge over the Thièle, some of these piles have been discovered. How long has it taken the Lake of Bienne, which has been silted up by various kinds of débris, to recede 3000 metres? In 1100 the Abbey of St Jean was built on the borders of this lake; in 1850 it was found to be at a distance of 375 metres (1218 ft.) from it; thus the shores had receded at the average rate of 50 metres (162 ft.) each century; from this it is easy to conclude that it had taken 6000 years to enable it to recede 3000 metres (9750 ft.). It is true that this number does not carry us back to the beginning of the present period, since the dwelling found at the Pont de Thièle is not the most ancient of the Swiss lacustrine habitations.

According to M. Mortillet, the chronometer which has been the most deeply studied amongst the accumulations formed by water courses, is that of the cone made by the Tinière. The Tinière is a torrent in the Canton de Vaud which falls into the Lake of Geneva at Villeneuve. At the point where it issues from the mountains on to the plain it has made a great cone of gravel and alluvium. The railway having bisected it for a length of 113 metres (367 feet) and at a depth of $7^{m}7$ (25 ft.), three undisturbed layers were plainly exposed to view, one bed of Roman earth containing tiles and Roman coins at a depth of $1^{m}20$ (4 feet), another bed of the bronze age at 3^{m} (9 feet 9 inches), and a layer of the stone age at $5^{m}70$ (18 feet). M. Morlot, who has described this trench most carefully, arrives at the following conclusions with regard to its value as a chronometer.

Age of the Roman layer	.	10 to 15 centuries
„ „ Bronze „	.	29 to 42 „
„ „ Stone „	.	47 to 70 „
„ „ entire cone	.	74 to 110 „

Thus the age of the entire cone, which can be traced to the end of the Glacial period, hardly surpasses the average already mentioned, following M. Arcelin.

M. Arcelin has arrived at analogous results[1] by the attentive study of the banks of the Saone. The river at present flows in a bed hollowed out in the midst of Quaternary alluvium; its banks are heightened by layers of mud deposited at each flooding of the banks. The Quaternary blue marl can everywhere be readily distinguished from the alluvium of the present time. In many different situations, numbering about thirty-three, M. Arcelin has studied the natural cuttings of the banks which have been laid bare by the waters of the rivers. He found, always at the same levels, some objects belonging to the Roman period, others to the bronze age, and others to that of polished stone. Knowing the age of the Roman strata, he could approximately arrive at the age of the other layers. This is the table he gives:[2]

Age of the Roman layer . . .	1,500 years
„ „ Bronze layer . . .	2,250 „
„ „ polished stone . . .	3,000 „
„ „ Quaternary marl layer .	6,650 „

These numbers are considered the minimum by M. Arcelin. De Quatrefages' opinion is that they would be less in reality since the amount deposited would increase as the lands became more cultivated, that is, during the last twenty centuries. However, the weight of the remark would be lessened if the fact be taken into consideration that the mass of water in the rivers has diminished since the

[1] M. de Mortillet, in the *Dictionnaire des sciences anthropologiques*, concludes that these results have been "revised and corrected" by M. Arcelin to bring them into agreement with the Bible. We should be very surprised at such an unjust accusation addressed to so conscientious a scholar as M. Arcelin, did we not know that each page of this Dictionary has been inspired, not by a love of science, but by anti-religious feeling. This narrow spirit is manifest in each article.

[2] De Quatrefages, *L'espèce humaine*, ch. xii.

Quaternary times, that the floods have been less frequent, that the rugged sides of the mountains laid bare by old erosions, offer less material to the water coursing down the slopes.

The calculations made by M. Kerviler at Saint Nazaire on the mud deposited at the mouth of the Loire have not obtained much favour with the learned world. The deposits of mud had not been regularly formed. The prehistoric layer could only be traced back to five hundred years before our era: this result differed too much from those already attained to receive much credence.

M. Forel has made some valuable observations on the gradual filling up of the Lake of Geneva. Whilst M. Arcelin's figures represented a minimum limit, M. Forel's indicated the maximum amount. One hundred thousand years is evidently an exaggerated number as we shall show, but it refers especially to the last Quaternary phase, not to our present time. In fact, as M. Arcelin said, "the alluvium studied by M. Forel was deposited at the bottom of the Lake of Geneva since the retreat of glaciers of the great extension." [1]

From all these tentative efforts we gather that an average of seven thousand to nine thousand years is sufficient to account for the phenomena accomplished in the present period.

2. *Quaternary period.* — The data referring to these distant times are still more vague, and the results still more uncertain. Our object being not to assert definitely, but to make known the attitude of science, we shall add a few words on these inaccessible antiquities.

Some authors have looked to astronomy to furnish the means of solution. They think that the alternations of the Glacial period were determined and ruled by the variations in the eccentricity of the earth's orbit; since the effects produced by these variations are alternately long and very cold

[1] *Revue des quest. scient.*, January 1895, p. 8.

winters, and shorter and warmer ones. But astronomers and observers of physical phenomena are agreed in repelling the hypothesis—1. This admitted lowering of the temperature could not explain the abundant fall of snow during the Glacial time. 2. These astronomical variations being regular, there would be ground for astonishment that these glacial phenomena had not been alternately produced before and after the Quaternary era. 3. The eccentricity which is cited as explaining the Quaternary glaciers, would cause them to have an antiquity of two hundred thousand years, whereas M. de Lapparent says, that more than eight or ten thousand years have not elapsed since the departure of the last American glacier, and the same may be said of those which were in Europe. Astronomy, therefore, is unable to furnish us with a chronometer with which to estimate the duration of the Quaternary epoch: at any rate it says nothing definite on the period which we seek to compute.

It would be unwise also to depend on the succession of fauna which is contemporary with Quaternary man. It is true that in the first Paleolithic phase, man lived in central Europe contemporaneously with *Elephas meridionalis,* then with *Elephas antiquus, Rhinoceros Merckii,* and *Hippopotamus major*; and during the second phase with the *mammoth* or *Elephas primigenius, Rhinoceros tichorinus*; and during the last receding of the glaciers, man lived at the same time as the *reindeer* or *Cervus tarandus.* But who can say how long a time was required for the advent of a special class of fauna or its disappearance? Is it possible to say exactly in what consists the substitution of one fauna for another? Since the fauna in our regions has not changed during the last five or six thousand years have we a right to conclude that a change of fauna requires some hundred thousand years? Simple climatic changes of condition are sufficient to produce in a few years a substitution of the fauna of the north for that of the south. It will then be better to seek for no chronological data from paleontology.

Will the alluvium of rivers and lessening of area of lakes give us more reliable information? Yes, certainly, if exaggerations are not admitted. According to M. Arcelin, the filling up of the Lake of Geneva would date from the departure of the great glacial extensions; that is from a time subsequent to that of which we seek to measure the antiquity. M. Forel considers that the Lake of Geneva, whose capacity was then 688 millions of cubic metres has now about one-third of its volume filled up. M. Forel estimates that the Rhone bears 221,670 cubic metres of sediment during the ninety days of the summer. If we suppose that this is the mean annual quantity carried by the river since the departure of the ice, the filling up of the third of the river must have required, in round numbers, one hundred thousand years. But as M. Forel has himself remarked, this number is an exaggerated maximum. Many considerations tend to lessen it considerably. 1. M. Forel supposes that the Rhone alone contributes to the filling up of the lake, whereas many small rivers have helped to swell it. 2. He considers that the Rhone only brings the river mud for ninety days in each year; it would be necessary then on this account to divide the number of one hundred thousand by four. 3. His calculation refers to the amount brought during the summer months, which are less prolific in water and sediment than the months of winter. 4. He assumes that the river supply has been constant, whereas in all probability it has diminished during the course of centuries. We cannot suggest a reduction: but it is evident that the preceding observations permit us to use a lower number. Moreover, this number, whatever it may be, only indicates the time which has elapsed since the departure of the great glacier, and not the totality of the duration of the Glacial epoch.

The most direct method would be to estimate the time required by the glacier in its movements of retreat and progression.

We do not conceal the fact that it is extremely difficult

to make a calculation, even an approximate one only. The glaciers do not move with an even step, they neither advance nor retire with a continuous movement; in the oscillations which take place at long periods, they undergo a number of secondary oscillations which retard the resultant progress. Moreover, if it is easy to decide the mean progress of any point of a glacier, it is much more difficult to find the average amount of the retreat of the whole face of the glacier when receding.

We must therefore avoid formulating a number,—even making a calculation. The most that can be done is to give a critical survey of the high figures brought forward by certain authors.

M. de Mortillet[1] gives the age of mankind as 230,000 or 240,000 years. He bases his calculations on the rate of movement of the glaciers, and on the alteration undergone by the limestone of Biolay near Aix-les-Bains.

The great Alpine glaciers have carried erratic blocks to a distance of 280 kilometres (910,000 feet). If we attribute to the Quaternary glaciers the same rate of speed as to the present glaciers, viz., $62^{m}66$ (202 feet) a year, it will be found that the distance was traversed in 4468 years. But this number, says M. de Mortillet, is too small to measure the Glacial period. 1. It only registers the extension of a glacier: it must at least be doubled to give sufficient time for the progression and retreat: in fact about 9000 years. 2. This number only measures the duration of glacial oscillation: now the Quaternary epoch includes many such oscillations, three at the least: in multiplying these figures by three we obtain 27,000 years. 3. The speed of $62^{m}66$ (202 feet) in a year is that of the glaciers on steep inclines: the more gentle an incline is, the more slowly the glaciers travel. Now the Quaternary glaciers only had steep inclines at their starting point: in the valleys they travelled almost entirely on gentle slopes. On an average the inclines of the Quater-

[1] *Formation de la nation française*, p. 234, Paris, Alcan, 1897.

nary glaciers were less steep by five times than those of the present glaciers: thus the speed was also five times less. The result is that the oscillations of the Quaternary glaciers require much more than 100,000 years.

We cannot admit all that constitutes this calculation. 1. According to M. de Lapparent the mean speed of the Mer de Glace is 0^m305 (cir. 12 inches) a day, which would conduce to an annual speed of 109^m (357 feet) or 100^m. To traverse 280 kilometres (910,000 feet) would thus require 2800 years only instead of 4468. 2. If we double this amount for the retreat and progression taken together, we arrive at 5200 years. 3. If we wished to treble this number in order to estimate the length of the three great oscillations we should obtain 15,600 instead of 27,000. But we have no right to treble the number used for the great glacial extension, seeing that the others being of less extent, must have had a shorter duration. 4. When judging of the Quaternary glaciers we do not consider ourselves justified in quintupling the number obtained by the consideration of the present glaciers. There are two chief factors which influence the movements of glaciers; the slope, and the condition of the ice, whether cohesive or not. M. de Mortillet is right: the Quaternary glaciers had only a small portion of their bulk on steep inclines, they moved for the most part on gentle slopes. But it must not be forgotten that the cohesion of ice is much less in the valleys than on the mountainous peaks: on the mountains the fusion of the surface is almost nil, consequently the ice is very cohesive; in the plains on the contrary, where the heat is greater, the fusion of the surface is abundant, and cohesion very deficient, so much so that the glacier approaches its limitations which is the liquid stream. Since all tends to show that the Quaternary temperature was equal to, if not higher than, that of the present time, the glaciers must have been very incoherent, and very close to complete fusion, consequently attaining a greater rapidity of movement. In our opinion the fact of the Quaternary

glaciers gliding over gentle but warm inclines leads us to consider the average rate of progress as equal to the speed of our present mountainous glacier. 5. Finally, it seems to be thought that the retreat of the glaciers takes as long as their progress. But this is not so: if the forward movement be regular and slow, the backward one is irregular, and sometimes very rapid. The forward movement is made only "en face"; but during a hot summer a large portion of the glacier melts, which sends its face suddenly some way farther back.

We put out these criticisms, not as final but tentatively, to show the reader how these enormous numbers may melt away as by enchantment, under the touch of reason.

The chronometers in which M. de Mortillet puts the most faith, are the limestone rocks of a hill, situated a little above Aix-les-Bains in the Savoy. The hill has been polished by the ancient glaciers of the Haute-Isère. Wherever the rocks have been preserved from contact with the air and water, by a layer of clayey earth, the polished parts are still very visible. But where the bed has been exposed to atmospheric action, corrosions of some depth have taken place. The Romans 1800 years ago quarried these rocks for stones, which they needed for some of their elevated constructions in that land; the surfaces left bare at that epoch have been eaten into by the atmospheric agents only to the depth of 2 or 3 millimetres, whereas the ancient corrosions on the same surface attain a mean depth of 1 metre. If in 2000 years the corrosion had been 1 centimetre, at the most 200,000 years would be required to account for a corrosion which was 100 times greater. Thus 200,000 years must have passed since the great glaciers abandoned the valley of Aix.

M. Louis Pillet, who was the first to put forward these figures, has since noticeably reduced them. Moreover, this result is not in agreement with those furnished by the other chronometers: all in fact give much lower figures than 200,000 for the time which has elapsed since the retreat of

the glaciers. Besides this there is an evident cause of error in the proposed calculation. It is supposed that the atmospheric agents always act with the same intensity: now during the Glacial epoch, marked by an abundance of rain and variation of temperature, the corrosions must have been produced with much greater rapidity than in the present epoch.

Confronted by these difficulties, we think it wiser to acknowledge that the duration of the Quaternary times is a problem with data so insufficient as to render it difficult of solution, even approximately only.

We will end this subject by repeating what was said, according to M. de Kirwan, at the Fribourg Congress in August 1897. M. Boulay, in dealing with the antiquity of man, says that the classic period of 6000 years is evidently insufficient and furnishes a minimum limit only, which must necessarily be exceeded. But must we therefore accept the 140,000 to 200,000 claimed by M. Hansen, or again the 230,000 to 240,000 which M. Mortillet considers indicates the length of man's sojourn on the earth? M. Boulay draws attention to the fact that this maximum amount, represented by these last figures, is not only entirely without proof, but does not even attain to great probability. However, they may perhaps be accepted provisionally as representing the maximum. It is between these two extreme limits, "a minimum of 6000, evidently less than the reality, and maxima dealing with hundreds of thousands of years, still more evidently exceeding this same reality, that we must direct our researches."[1]

Conclusion.

1. We learn from celebrated exegetists, that the Bible does not impose a chronology upon us. The freedom which is the result appears to us to be very important, since on the

[1] De Kirwan, *Le Congrès de Fribourg*. *Revue du monde catholique*, October 1897.

one side the wish to find the Bible mistaken had not been without some influence on those who accorded a fabulous antiquity to man; and, on the other side, the desire to preserve an ancient interpretation doubtless led Catholics to accept figures which were too small in spite of scientific data.

2. The monuments recently discovered in Egypt and in Chaldæa show us that an advanced civilisation already reigned in these countries four or five thousand years before the Christian era. Without instructing us concerning the commencements of humanity, they teach us to give a more ancient date to the origin of mankind.

3. We may go back to the beginning of the Quaternary era for the first traces of humanity. The pretended signs of Tertiary man have been deprived of probability.

4. The time which has elapsed since the first appearance of man can be divided into two parts: the present epoch, which the general opinion is unanimous in considering (and justly) did not exceed seven or nine thousand years, and the Quaternary epoch, of which it is impossible with our present knowledge to estimate the length. The criticisms we have made of certain calculations have shown that it is well to be guarded in accepting results not accredited.

5. It being understood that the veracity of the Bible is not under dispute in this question, there is no reason why we should, *à priori*, mistrust figures which science after due examination has offered for our consideration, on the antiquity of man. In the present state of science we have no right to affirm that a number nearer to the truth could never be suggested to us.

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CHAPTER VII

THE CONDITIONS OF THE LIFE OF PRIMITIVE MAN

§ 1. *Preliminary Observations.*

THE history of the condition of primitive man is intimately connected with all that has preceded this chapter. If man had been slowly evolved from the lower animals, in going through the course of his history we should find transitional phases through which he passed in arriving at what he is; intermediate stages by which the merest rudiment of intelligence was gradually unfolded and developed. This is the argument of the partisans of the theory we are about to combat.

If, on the contrary, as we have sought to show, man has come straight from the Hand of God with all the faculties which co-exist with his nature, then we should find him, from his very first appearance, a completely equipped human being; he must be the same in all ages, both physically and intellectually. Certainly from his power of adaptation to varying circumstances of place and climate, his physical appearance has naturally been altered into diverse types; but these modifications are purely accidental. Thus, man being endowed with intelligence and consequently capable of progress, in the process of time he must necessarily have created works which by degrees became more and more perfect; but from the very beginning these works were the fruit of man's characteristic mental faculties. Such is the argument we shall seek to establish.

In proving that man was intellectual from the beginning of his existence, we emphasise the privileges which distin-

guish him; the spirituality of his soul, his origin, truly divine, the specific unity of the human groups. Whatever period be assigned as the date of his creation, vast ages since or comparatively recent, sufficient time must always be allowed to account for the formation and development of even the most advanced nations.

In order to establish more firmly their arguments the materialistic anthropologists have recourse to two kinds of proof. They call to their aid the evidences of the prehistoric times: and try to find in the most ancient human remains, whether bones or implements, signs of a transitional state between the animal and human nature. Then studying the recent savages they look upon them as late developments still only half-way on the road towards civilisation.

We shall get our information from the same sources. After describing the objects of the primitive handicrafts, and giving accounts of the traces left by the most ancient races, we shall be in a better position to establish the fact that the identity of type, physical and intellectual, is clearly proved through thousands of slight variations of but little importance. Then, for our own purpose, taking recent savages, we shall show that, far from being behindhand in the path of development, these races possess a nature quite as complete as our own, and that their present condition is a degeneration from a former higher state.

To avoid confusion, we shall chiefly study the traces left in Europe by the early human races. They have been more carefully and more extensively examined there, than in other parts of the world: they lend themselves to classifications which, if not quite certain, are aids to study: in other countries, however, the remains of primitive man are obviously the same, and since the antiquities can be traced to the Glacial period, the European proofs should carry us back very close to the commencement of the human race.

We shall now examine the facts which prehistoric times furnish. These facts are numerous enough to enable us to

have some idea of the primitive races of Europe. Naturally they do not answer all the questions our curiosity prompts us to put to them. But they will nevertheless teach us much, if they prove that man has always been what he is to-day, an intelligent being ; and that the differences between primitive man and the modern savage only relate to the degree of development of the same faculties.

§ 2. *Prehistoric Archæology.*[1]

In arranging the records of prehistoric times, we shall treat together the succession of the fauna and the variations of workmanship. These two divisions are not so distinctly separated as they appear to be in the classified tables. Moreover, the new discoveries may displace the present lines of demarcation. Even if the facts are true, and their sequence well established, the grouping still remains artificial and temporary :—

	TYPES OF IMPLEMENTS FOUND AT		FAUNA.
I. Paleolithic, or chipped Stone Age.	*Chelles*		**1. The Elephas meridionalis** **2. Elephas antiquus.**
	Saint Acheuil		**3. Transitional.**
	Moustier *Solutré*		**4. Elephas primigenius.**
	La Madeleine		**5. Reindeer.**
	Various	Mas d'Azil Shell finds Tardenois Campigny	**6. Transitional.**
II. Neolithic, or polished Stone Age.	*Robenhausen*		**7. Recent.**
III. Metal Age.	*Copper* *Bronze* *Iron*		

[1] I must here thank my young friend, M. l'Abbé Breuil, for the zeal with which he has collected and classified the latest prehistoric objects of interest ; his own researches in the domains of prehistoric times give him a competence for the work which I highly appreciate.

Fauna of the 1*st and* 2*nd Periods: Elephas meridionalis, Elephas antiquus.*

IMPLEMENTS OF THE TYPE OF THOSE FOUND AT CHELLES.

The oldest human worked flints known at the present time, were found by M. d'Ault of Mesnil, associated with the Pliocene fauna in the lower Quaternary formations, in the neighbourhood of Abbeville; and also by MM. Boule and Capitan at Tilloux (Charente-Inférieure). These alluvial deposits at Abbeville and Tilloux indicate a transition from the Pliocene to the Quaternary periods, and are considered by geologists to be contemporaneous with the first glacial invasion.

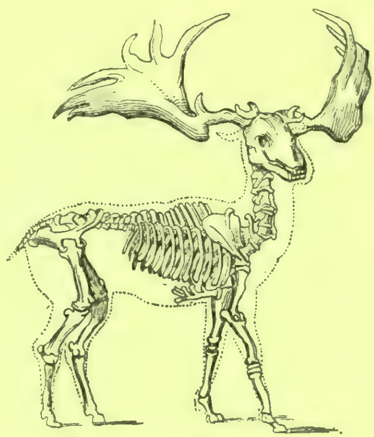


FIG. 98.—Skeleton of *Cervus megaceros*.

The fauna of the lower Quaternary epoch at Abbeville is identical with that of S. Prest (Eure-et-Loir). Some specimens indicating the Pliocene period have been found there, such as *Elephas meridionalis*, *Trogontherium Cuvieri* (a large rodent allied to a beaver), *Machairodus latidens* (an animal of the tiger tribe, with enormous upper canine teeth, with serrated edges).

At Tilloux, the Pliocene fauna is only represented by *Elephas meridionalis*, this is associated with a fauna like that of Chelles (Seine-et-Marne), which is clearly Quaternary.

Chelles is the classic locality where these characteristic remains were found. The fauna of this station comprises: *Elephas antiquus*, *Rhinoceros Merckii*, both derived from the Pliocene types (*Elephas meridionalis* and *Rhinoceros leptor-*

hinus); it also includes *Hippopotamus major*, *Cervus megaceros* (Fig. 98), etc.

A fauna so rich in large pachyderms and herbivorous animals, would require a luxuriant vegetation for its sustenance. A warm damp temperature encouraged the growth of plants fit for fodder. A heavy rainfall gave rise to numerous phenomena characteristic of the Quaternary epoch: in the plains the water courses frequently overflowed their banks, these floods exposed gravel beds, which were subsequently occupied by man, who has left traces of his handiwork; in mountainous regions the abundance of snow caused the formation of glaciers. The first glacial invasion, though little felt in France, no doubt coincided with the fauna of Abbeville; the second invasion, which was much more considerable, is placed between the post-Pliocene fauna of Abbeville and that of Chelles.

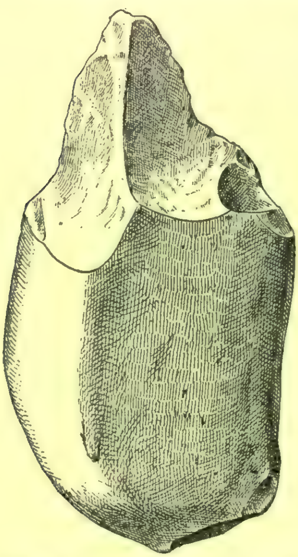


FIG. 99.—A Flint Implement or dagger, of the type found at Chelles; chipped only at one end.

The implement which characterises this epoch is made from a nodule of flint or piece of quartz, or from some other equally hard stone; it is made by repeated blows on the two surfaces, in such a way as to form a slender point, the flint is left thick at the base and middle, but chipped thin and sharp at the sides and point. Generally the natural surface of the block or nodule is left untouched at the base, to enable the hand to hold and wield this heavy implement without injury, thus making a weapon of it (Fig. 99). The flakes which were struck off when this flint was made were sometimes used, but always without being further worked.

The first advent of this primitive implement seems to be easily explained. Whilst using a nodule or block of stone of any kind, man might have accidentally chipped off large fragments of the flint. His natural intelligence would then lead him to mark the added perfection which this accidental breakage gave to his tool, he would then reproduce it intentionally.

Man of this period progressed but slowly; how could it be otherwise? Always fighting against the adverse powers of nature, which were immeasurably beyond his own strength, man's energies were entirely absorbed in the struggle for existence. In order to make progress, man requires peace; to invent, he requires leisure.

The implements found at Chelles could hardly have been used as weapons for hunting; at the most, they could only have served as weapons of defence, they were more probably implements of husbandry, by the help of which roots were dug up.

FIG. 100.—Portion of a skull found at Denise (Haute-Loire).

We know nothing of the means of sustenance of these primitive people. We are also ignorant of their religious and social condition. There is nothing to tell us whether fire was known, or clothing used, nevertheless the absence of proof does not necessarily imply that fires and clothing were not used.

With regard to the evidence of human remains of this period, we only possess those found in 1884 near Puy (Haute-Loire) (Fig. 100), amongst the scoriæ from the extinct volcano of Denise. These indications of man consisted of a frontal bone, the genuineness of which is established by the thick incrustations of clayey mud which were observed in the interior. These remains appear to be identical with those of the Neanderthal races, to which we shall allude presently.

The civilisation of the races, similar to the type found at Chelles, appears to have preceded that of any other country. Professor Flinders Petrie and de Morgan noted indications

of it amongst the ancient alluvial deposits of the Nile, and signs of it have been encountered over the whole of Europe (except in the extreme north), in Syria, Palestine, Persia, in the Indies and Sahara, in Algeria, in Somaliland, at the Cape, the Congo State, in Gabon, and in America.

Some of the savages in Australia have descended from those living at the time of this primitive civilisation, and at the present day employ implements of the same types mounted in ordinary handles.[1]

3. *Fauna of the Transitional Period.*

ARCHÆOLOGY OF SAINT ACHEUL.

There is good reason for separating the previous type of implements from those found at Saint Acheul, since the specimens found at Saint Acheul, near Amiens, and those in the neighbourhood of Abbeville, discovered by Boucher de Perthes and Lartet, differ from those of Chelles, whether we look at the shape and workmanship of the implements, or the animals found associated with them.[2]

The fauna characterised by *Elephas antiquus* seemed gradually to die out, or rather to adapt itself to new climatic

[1] Books on this Period: D'Ault du Mesnil: *Note sur le terrain quaternaire des environs d'Abbeville*, *Revue de l'Ecole d'Anthrop.*, 15th Sept. 1895, p. 284.—Capitan: *Revue de l'Ecole d'Anthrop.*, 15th Nov. 1895.—Boule: *L'Anthropologie*, 1895, n° 5, p. 497.—Sal. Reinach: *Le préhistorique en Egypte*, *Anthropologie*, viii. n° 3, p. 327.—Zumoffen: *L'âge de pierre en Phénicie*, *Anthrop.*, viii. n° 3, p. 272.—De Morgan: *Recherches sur les origines de l'Egypte*, 1897. Paris, Leroux.—*Instruments paléolithiques chez les Sômalis*, *Anthrop.*, vi. p. 393, vii. p. 341, vii. p. 567.—*Sur l'Amérique du Nord*, *Anthrop.*, iv. p. 36, vii. p. 726, viii. p. 212, viii. p. 489.—*Sur l'Amérique du Sud*, *Revue d'Anthropologie*, 1880, p. 4.

[2] Boucher de Perthes (1839) and Lartet are rightly considered as the chief discoverers of prehistoric implements. Before them, de Jussieu (1723), Mahudel (1730) in France, John Frere (1800) in England, Schmerling (1833) in Belgium, had in vain drawn the attention of learned men and of the public to the worked flints and their true nature. It was not until after fifteen years of persevering efforts that Boucher de Perthes succeeded in uprooting the old prejudices from the mind of the public, who looked upon those chipped flints as thunderbolts or the results of natural fractures.

conditions. The appearance of *Elephas primigenius* (Mammoth) (Figs. 101 and 102) and the *Rhinocerus tichorhinus* (Fig.

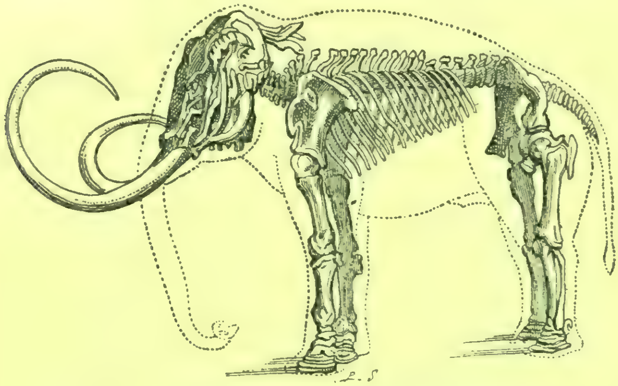


FIG. 101.—Skeleton of *Elephas primigenius* (Mammoth).

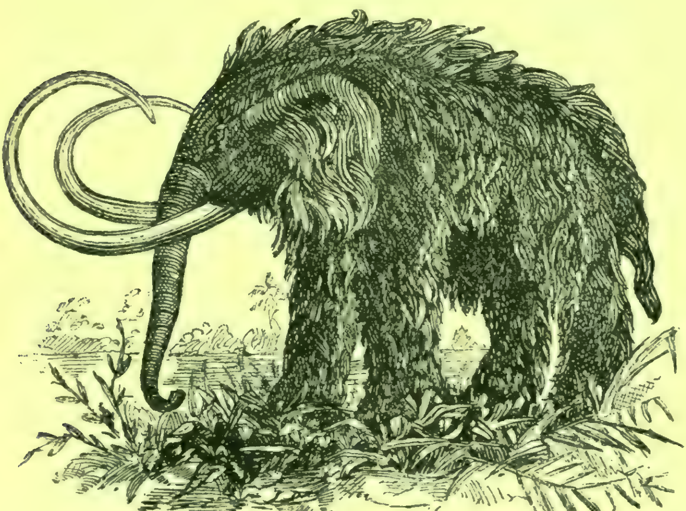


FIG. 102.—Restored figure of a Mammoth (*Elephas primigenius*).

103) took place at this time; both animals were covered with thick woolly hair. Associated with them were numerous

horses, bison, aurochs, deer (*Cervus megaceros* and *canadensis*). These were preyed upon by several large carnivora, such as *Ursus spelæus*, *Felis spelæa*, and *Hyæna spelæa*.

This fauna indicates a climate not quite so warm as the one preceding it, but it was equally damp, the vegetation being most luxuriant. The hollowing out of the valleys still went on, and alluvial deposits were abundant.

The workmanship of the implements found at Saint Acheul was clearly the result of a slow but progressive improvement of those of Chelles. Man had in view the greater symmetry and lightness of his tools. He improved

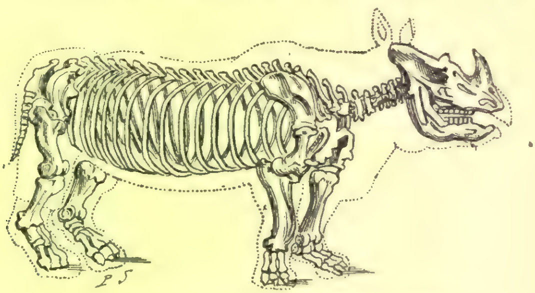


FIG. 103.—Skeleton of a Rhinoceros (*tichorhinus*).

little by little the cutting edge of his stone daggers, and gradually transformed them into useful weapons (Fig. 104).

The flint implements were thus gradually separated into many types, the different forms into which they were chipped adapted them to various uses, although they diverged more and more from the original design of their prototype. Many have an almond shape outline (amygdaloid type); others are oval or elongated into a slender lance-like point. The workmen at Saint Acheul likened them to the "tongue of a cat." Their size and workmanship vary much. At the beginning of this period the large dagger-like implements were very numerous, as at Saint Acheul itself; towards the end, on the contrary, these flint implements were superseded by others hardly more than 5 or 6 centimetres ($2\frac{1}{2}$ in.) in length, such as

those found at La Micoque (Dordogne). Many of these might have been used as arrow-heads, knives, and awls. Some of the weapons are almost round, and pass imperceptibly into another variety characteristic of a later time, viz., the disc.

All these implements to which reference has been made were chipped from a small nodule of flint. The flakes which were struck off in this manufacture were used during the earlier period, but not in great numbers, and were not chipped at the edge; but, on the other hand, during the Acheulian period they were much more frequently employed, and generally altered by secondary chipping. At La Micoque (Dordognes) twenty worked flakes were found to one implement which was chipped or worked on both sides: these flakes were used chiefly as arrow-heads and scrapers.

FIG. 104.—A Flint Implement, similar to those found at Acheul; made from a nodule of flint, worked on both sides, and re-chipped on the edges.

The man of this epoch lived by hunting; the large number of split bones belonging to a species of horse found at La Micoque, associated with flint implements, shows that man supported himself on the flesh of the horse and split the bones to obtain the marrow. The awls and scrapers which abounded in all the stations belonging to this period lead us to think that man prepared the skins of the animals he had eaten to clothe himself.

During this period no trace of fire has as yet been found, and there is total absence of evidence with regard both to the

social and religious conditions, since the few human bones which have reached us from these distant times do not come from burying places. The human remains which we possess of the man of Saint Acheul closely resemble the better known type of the man of Le Moustier, which we shall presently describe.

The type of implements of the Acheulian period seem to have been as widely spread as those of the preceding epoch, from which they are only distinguished by their better workmanship.[1]

4. *Fauna of the Mammoth Period* (*Elephas primigenius*).

A. ANTIQUITIES OF LE MOUSTIER.

Two stations where implements are found correspond in time with the Mammoth period, that of Le Moustier (a village of Peyzac, Dordogne); and Solutré, a village situated near Mâcon, where there is a layer containing a considerable number of these implements.

The fauna of this period, characterised by the presence of *Elephas primigenius*,[2] indicated a cold climate. Many of the animals which survived were obliged to emigrate to frozen lands or to the mountains; for instance, *Ursus ferox*, the musk ox, *Cervus canadensis* of North America, the antelope saiga of the frozen steppes of Central Asia, the reindeer, the glutton, the Arctic fox, the lemming of the polar regions, the marmot, the wild goat and the chamois of the lofty mountainous groups of Europe.

Notwithstanding the cooling of the temperature, the atmo-

[1] Books on the period.—Capitan: *Station acheuléenne de la Micoque*, *Revue mens. de l'Ecole d'Anthropologie*, 6e année, 15 nov. 1896, p. 406.—D'Ault du Mesnil: *Note sur le terrain quaternaire des environs d'Abbeville*, même *Revue*, 15 sep. 1896.—Hamy: *Précis de paléontologie humaine.* Paris, 1870.—Boucher de Perthes: *Antiquités celtiques et antédiluviennes.* Paris, 1847 et 1864, etc. . . .

[2] The Mammoth appeared at the commencement of the Quaternary age; the changes characteristic of the Mousterian period began after the Acheulian epoch.

sphere was still very damp; this fact explains the rarity of the reindeer, the musk ox, and the lemming, which prefer a dry cold.

Man of this period suffering from the rigorous climate began to make clothes from the skins of beasts. This handiwork extends throughout the whole of the Mousterian period, and the implements designed for the manufacture of clothes gradually become more perfect. These consist of knives to open and flay the animals; scrapers to clean the skin and make it supple; and pointed knives to cut and shape it.

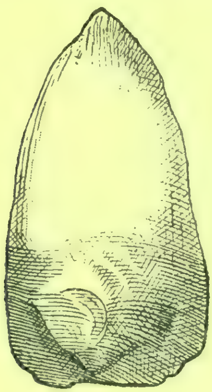


FIG. 105.—Large flint flake of the Mousterian period, chipped on one side only; the plain surface.

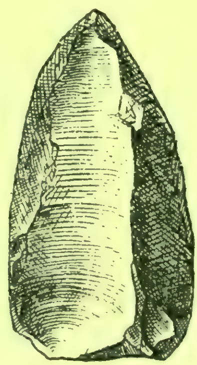


FIG. 106. — Large Mousterian flake showing the chipped surface.

These various tools are not the outcome of a single invention,[1] they appeared gradually, and when once adopted for a special purpose, were retained, without variation, for a considerable time (de Mortillet). They were in use from the Acheulian epoch, but abundant in the next, and are representative of it; at the same time the large rounded flint which had developed into an equilateral triangle, disappeared.

In the manufacture of the pointed implement or dagger,

[1] In the earlier times at Montsoué (Landes) man did not know the use of knives; if by accident, he struck off a flake of the long knife-like type, he altered it into a scraper.

the core or nucleus of the block only is used, whereas for the tool of the period of which we are now speaking, the detached flakes are the parts utilised. The dagger is chipped on both surfaces at all points of the circumference, and especially round the edges; but in the implements formed from the flakes, one side of the detached flake remains smooth and polished, the other side only is worked (Figs. 105 and 106).

The scraper is a flake chipped round one of its lateral edges; it takes the form of an arc or portion of a circle (Fig. 107). The arrow-heads, the harpoons and the awls are all chipped on both sides, but chiefly towards the point, to make them sharper. It is possible that the arrow-heads of Moustier have served the purpose of a dart; in that case, it would be in a handle.

Fig. 107. — Mousterian Scraper.

We have no direct proof that the workmanship of bone and ivory was known at this epoch. But since very well worked ivory has been found at the commencement of the Solutrian period which succeeded it, we have every reason to conclude that further researches will reveal the working of bone even in the Mousterian times.

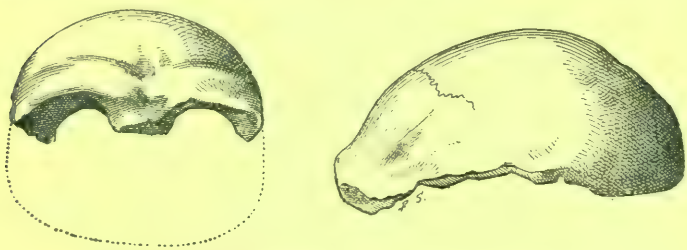
The condition of man's religious ideas at this epoch is as little known to us as that of his predecessors; of his manner of life we know more. Already at La Micoque (Dordogne) man of the type of those discovered at Saint Acheul, heaped together pell-mell, the refuse of his meals and handiworks; these furnish the first indications of his domestic and social life. These accumulations of waste matter, increased during this period; they are usually met with at the foot of sheltered embankments, or in little caves where man sought a refuge from the cold. The heaps of refuse under the rocks of Le Moustier (Dordogne) and Chez-Pourret (Corrèze), and the other rock shelters of this period, have shown no signs of cinders, or fuel, nor of flints cracked by fire. The

use of fire is only evident at the end of the Mousterian period.[1]

Man lived then by hunting. He did not fear the attack of the Mammoth and occasionally killed a large number, as is proved at Cœuvres (Aisne).

The various human bones which this epoch furnishes enable us to reconstruct the type of man found at Moustier. We will study the layers of earth containing his remains, and then describe the kind of man which they reveal.[2]

The skeleton of *Neanderthal* (Figs. 108 and 109) comes from the little cave of Feldhofen on the right bank of the Düssel



FIGS. 108, 109.—Neanderthal Skull, side and front view.

(1857). It was found at about a depth of 0^m66 (2 feet) in ancient loam or mud heaped together which had not been disturbed. In another cave, distant only about 130 paces, the remains of rhinoceros, hyæna, and bear were found in a similar kind of deposit.

At *Eguisheim* (Fig. 110), near Colmar, on the left bank of the Rhine, a portion of a human skull was discovered in 1855

[1] At Spy in Belgium there are two superimposed layers of flint, such as was found at Moustier; in the more recent formations there were several hearth slabs associated with ivory and bone implements, Mousterian arrow-heads, scrapers and chisels. The presence of worked bones inclines us to the belief that this layer of implements must be considered as contemporaneous with the antiquities found at Solutré. The implements are so well preserved in the countries in the north, as to be nearly connected with those of the Neolithic age.

[2] We shall say nothing of the skull of Canstadt, although de Quatrefages considers it the type of the most ancient human race; its authenticity is much disputed.

at a depth of 2^m50 (8 feet) in undisturbed loam. These deposits contained the remains of *Cervus megaceros* and the Mammoth.

A fragment of a skull was found at Marcilly (Eure) (Fig. 111) in 1884, 7^m (22 feet) deep in clayey soil. It can only be dated approximately by taking into consideration

FIG. 110.—The Eguisheim Skull (Haut-Rhin).

the layers of brick-clay surrounding it, where deposits of Mousterian flints were found associated with numerous remains of the Marmot.

Another skull, much more complete, was found (1893) in a stratum of the same nature at Bréchamp (Eure-et-Loir) (Fig. 112).

A remarkable jawbone comes (1866) from a cave on the left bank of the Lesse, called Naulette Hole (near the village of Furfooz, Belgium) (Figs. 113 and 114). The ground was composed of seven stalagmitic layers; the jawbone was embedded under three layers at a depth of 5^m (16 feet); it was accompanied by other human remains, as well as long bones belonging to the Mammoth and the *Rhinocerus tichorhinus.*

FIG. 111.—Piece of Skull from Marcilly-sur-Eure.

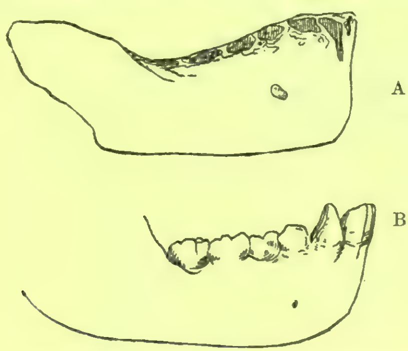
The cave of Malarnaud (Fig. 115) in the valley of the Arize (the basin of the Garonne) furnished a curious jawbone (1889). This jawbone was at a depth of 2^m ($6\frac{1}{2}$ feet) under a stratum of stalagmite, covered with rubbish, together with the remains of *Felis spelœa, Ursus spelœus, Rhinocerus tichorhinus.*

Two skeletons were discovered at Spy (Belgium) (Figs. 116 and 117), where they were excavated from an undisturbed Mousterian bed. They were at a depth of $4^{m}50$ ($14\frac{1}{2}$ feet) under an osseous breccia, solid and difficult to remove. With

FIG. 112.—The Bréchamp Skull (Eure-et-Loir).

them were collected flints of the type found at Moustier and Mammoth bones.

England has also contributed remains of two men of this period. The first was found in 1883 at *Tilbury*, near London



FIGS. 113, 114.—The lower jaw from Naulette (A) compared with the jaw of a Chimpanzee (B).

(Fig. 118), in alluvial deposits on the left bank of the Thames. It was embedded in a layer of sand at a depth of $0^{m}50$ ($1\frac{1}{2}$ feet) under 10^{m} (32 feet) of deposits, alternately of mud and peat. The other, of which only a portion of the skull

has been recovered, was found at *Bury St Edmunds* in the valley of the Linnett amongst a pocket of clayey deposit, overlying the chalk. It was associated with flint implements of the type found at Saint Acheul, and the remains of the Mammoth.

We have now referred to the remains of about ten skeletons. Those of Spy, Naulette, Malarnaud, and Denise (Chellean) can be accurately dated. The others can only have a probable date affixed by comparing them with the deposits of the surrounding strata. If by a close criticism the value of these records were called in question, the account of the Mousterian man would not be materially altered.

FIG. 115.—Lower Jaw from Malarnaud (Ariège).

The man of this period had a long elliptical skull, in consequence of the unusual development of the hinder portion and the narrowness of the forehead. The Neanderthal skull is contracted on either side behind the orbits. The thickness of the cranium is about 1 centimetre, whilst the Denise skull, which belongs to a young person, is only 6^{mm} 5 thick.

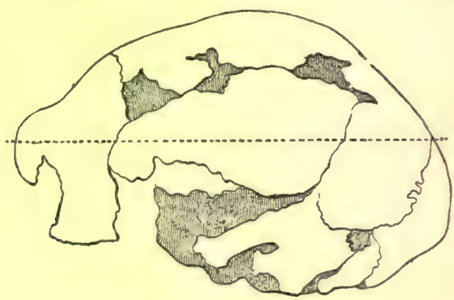


FIG. 116.—Skull of Spy, No. 1.

The cranial capacity (Neanderthal) is 1220^{cc}, this is less than the present average (1500^{cc}), but it is still very far removed from that of the monkeys (500^{cc}).

The hinder portion of the skull is wide, capacious, and grooved, with a sloping occiput. The frontal bone is elliptical and narrow, the facial bones are lacking. The supraciliary ridges are very strongly developed, sometimes even enormous

FIG. 117—Skull of Spy, No. 2.

(Spy, No. 1, Neanderthal), though little arched. The orbits, hardly wider than high, give the impression of a round eye.

The upper jaw is strong and well developed ; the nose, which appears depressed under the brow ridges, must have been wide and flat.

The lower jaw is also strong. The horizontal portion is of a low type, and thick, forming ridges as it slopes backwards and downwards, exhibiting underneath a wide, flat surface; the chin is not prominent, the triangle of mental[1] processes is not marked, the line of the juncture of the jaws slopes backwards; the mental process is hardly perceptible.

FIG. 118.—Skull of Tilbury (London).

The teeth are strong, the molars increase in size from the front to the back.

The ribs are rounded and abruptly curved at the angle, showing great power of the thoracic muscles, and consequently a strong and well developed chest.

[1] From the Latin mentum = chin.

Great strength also characterises the clavicle, the scapula and the pelvis.

The humerus, which is short and thick, has a decided curve, and strongly marked muscular impressions. The coronoid and olecranic cavities are very deep, but not perforated. The radius and the ulna, although very thick, are in proportion much less so than the humerus. The radius of Spy has an inner concavity which is opposite to a concavity on the outer side of the ulna.

The femur is very strong, heavy, and thick, and has impressions and ridges, indicating great strength in the muscles inserted in them. In that at Tilbury a third trochanter was found between the other two. The tibia, which is short, thick and strong, exhibits a well developed upper portion, but is slightly bent.

The hands are large and long, and the feet still more so.

The height of the man of this period was $1^{m}60$ (5 feet).

All these characteristics tend to show that Mousterian man was a vigorous, powerful being, and not degenerated as is a savage of the present time.

Remains similar to those of Moustier have been found in England, Belgium, France, Italy, Syria in Palestine, the Crimea, Russia and Western Siberia.[1]

B. ARCHÆOLOGY OF THE TYPE FOUND AT SOLUTRÉ.

The Mousterian fauna lasted as long as the climate remained damp. But in proportion as dry weather prevailed, so the fauna underwent changes.

In those countries bordering on the sea coast, the moist climate continued, particularly in the north and south-west of France: the vegetation remained arborescent and the pachyderms abundant (Brassempouy, Landes). In those

[1] Books on this period.—Hamy: *Précis de Paléontologie humaine*, ch. viii.—Memoirs by M. Lartet and Mr Christy.—Lubbock: *Prehistoric Times*, vol. ii. Cartailhac: *La France préhistorique*, ch. iii.—De Mortillet: *Formation de la nation française*, etc.

regions possessing a more uniform climate, the humidity was less; nevertheless a very luxuriant herbaceous vegetation was maintained, which enabled horses to live in large numbers (Solutré, Saône-et-Loire).

At that time man was acquainted with the use of fire. At first he used wood only for heating his pots; at a later period he replaced the wood by dried grass for lighting, and by offal for maintaining it.

In the north of France indications of the Mousterian period prevailed; but in Belgium at Spy, fire was known and ivory worked.

The basins of the Loire, the Charente, the Dordogne, the

FIG. 119.—Flint borer, point at each end; Solutrian.

Adour and the Saone, early showed signs of remarkable progress, as evidenced by various phases of Solutrian manufacture, but the special workmanship is not met with out of France, and is restricted to certain parts of France.

The methods of working flint were not perceptibly altered at first; a few tools were added to the Mousterian implements, designed for the working of ivory and bone: these were thick scrapers, flint carving tools, awls (Fig. 119), chisels (flints which have an edge at an angle with the line of chipped surface).

At a later period we find the lighter scrapers, sometimes circular, sometimes formed from long flakes, chipped towards the end on the upper surface. Lance points of varying shapes also appear. That in the shape of a laurel leaf takes some-

time a lozenge form (Fig. 120), the willow leaf arrow-head is longer; both are finely chipped on the two sides. This fine work, so delicately and so skilfully performed, is obtained by a new process, not by blows, but by strong pressure on the edges. The barbed arrow or lance head (Fig. 121) is smooth on one side and finely chipped on the other; one of its edges is sloped and scooped out so that the lower part is

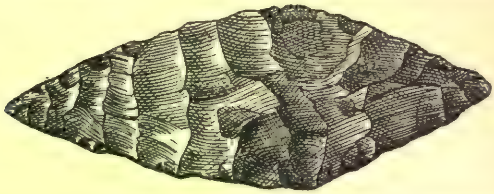


FIG. 120.—Lance-point, of a laurel leaf shape; Solutrian.

narrower than the upper, and thus could be readily fastened into a handle, Many implements have been formed from bone and ivory; they are for the most part slender, awl-like tools, arrow-heads or bone pins.

Ivory and bone being more easily worked than flint enabled man to produce works of art.

A study of these weapons well reveals the progress of the power of conception and human intelligence.

When man for the first time wished to carve his own likeness

FIG. 121.—Single barbed lance-point, carefully worked and well finished; Solutrian.

or that of an animal, he made it in miniature; it was in fact a statuette. To this first phase of art, when carving in high relief existed, we owe the statuettes of women of Brassempouy (Landes), the little figures of animals and women found at Laugerie (Dordogne), at Bruniquel (Tarn-et-Garonne), at Mas d'Azil (Ariège), as well as the rough sketches of Solutré (Saône-et-Loire).

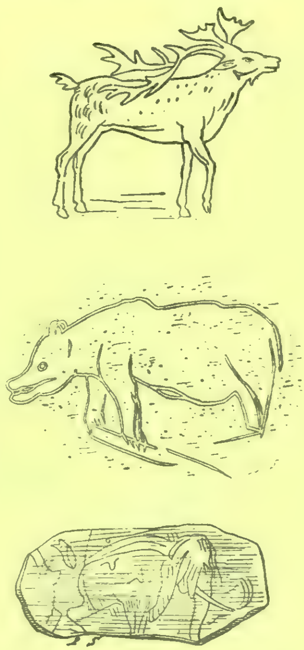
At a later period, in order better to represent the figures, and give greater boldness to the attitudes, they were sculptured in low relief.

The great difficulty presented by that sort of work gave rise to two other methods: engraving with outlines cut out, and engraving on a raised field, by which a very considerable part of the ground was removed,

The products of the first are thin bone plates, cut out so as to make a silhouette of the object, a horse's head, or an ibex head for instance; on that plate they drew with a fine flint point, and by lines and hatchings they represented the prominences and folds of the model.

In the engraving on a raised field, the plane surface stands out in relief on a slightly hollowed ground, then line-drawing completed the details.

This latter method was almost the only one used at the end of the Glacial period. To it we owe the likeness of the greater part of the animals inhabiting our countries at that time, viz., the horse, antelope, mammoth, cave-bear, etc. (Figs. 122 to 124).



Figs. 122, 123, 124.—Reindeer, great bear and mammoth carved on bone or stone belonging to the Quaternary epoch.

These works of art are simple, but testify to consummate skill in the execution, and show that the artists were close observers of nature, sometimes even adding imaginative touches to their imitations of nature. The most noticeable characteristics of species, the sex, prominent muscles, are always well marked.

The Solutrian man dwelt in natural caves as at Brassempouy (Landes) and at Mas d'Azil (Ariège) or at the foot of a sheltered embankment, as at Solutré (Saône-et-Loire) and at Laugerie-Haute (Dordogne). Being very active in the chase, he slaughtered many large animals for his nourishment, the mammoth and rhinoceros (lower bed at Brassempouy) bison, *bos primigenius*, large deer, and horses, (middle bed at Brassempouy, Solutré).

The horse was probably half domesticated: as certain drawings represent it wearing some kind of harness on the head (Piette).

From a piece of sculpture in bas-reliefs we learn that barley was already known, if not cultivated (Piette). The cave of Espélugues at Lourdes and the rocky shelter of Bruniquel (Tarn-et-Garonne) both furnished a sculpture of an ear of corn in high relief (Piette).

We know also by the human representations that man gave some consideration to his clothing. The head of a woman in ivory, found at Brassempouy, is covered with a veil, which also falls on the neck. Two other statuettes of the same origin show us a cloak and a kind of sash (Piette).

Trinkets were not disdained. The necklace found in the Duruthy cave at Sordes (Landes) is a proof: it was formed of more than forty canine teeth of the bear and lion and embellished with carving. The ornaments of bone and ivory must have been used as pendants, as they often have holes by which they could be suspended. Shells also served as trinkets.[1] Man also liked to adorn his tools: the handles of his poniard are carved with great care.

[1] The study of shells, whether fossil or recent, which have been used as ornaments, helps to decide the extent of migration, or the commercial relations of the Solutrian population. Thus the inhabitants of the cave of Mas d'Azil evidently visited the shores of the Mediterranean and the Ocean, but they did not pass beyond the Garonne on the north: the fossils foreign to this neighbourhood came from the faluns of Bordelais and Dax, and the recent shells belonged to the two seas, whereas the fossil shells met with in the Solutrian caves of the Dordogne have been taken from the geological beds at Touraine. (H. Fisher.)

As yet no trace of burial,—no trace of religious rites is met with.

We possess few remains of the Solutrian man. The jaw of d'Arcy (Yonne) probably goes back to the commencement of the Solutrian times: it was found with remains of the Mammoth fauna under a layer of earth of the Magdalanian period. The chin is indicated by a triangular projection with a central depression corresponding to the dimple; the line of the suture of the mandibles does not project in a forward direction, nor does it take a backward slope; the bony framework is lighter than with Mousterian races.

FIG. 125.—Lower jaw of d'Arcy-sur-Cure (Yonne).

The skeleton of Sordes (Landes) dates from the end of the Solutrian period. As far as can be judged in its dilapidated condition, this skeleton has a great analogy to the Magdalanian fossil remains, which we shall presently study.[1]

5. *Fauna of the Reindeer Period.*

IMPLEMENTS AND SPECIMENS FOUND AT LA MADELEINE.

The result of the dry cold was to drive out of our countries the great animals of the Mammoth type. Thus the fauna of the steppes became established in a large portion of Europe, the reindeer almost entirely replaced the horse as food.

Although the atmospheric conditions were hardly favourable to vegetation, yet the forests did not entirely disappear from the south of France. Refuse of flesh was still burnt in

[1] Books on the Solutrian period—Lartet et Christy: *Reliquiæ Aquitanicæ.* —Arcelin: *Solutré*, 1872.—Chabas, *Les silex de Volgu*, Report given to the Historical and Archæological Society of Chalon-sur-Saône, 1874.—Ferry et Arcelin: *Age du Renne en Mâconnais*, 1868.—Ferry: *L'ancienneté de l'homme dans le Mâconnais*, 1867.—Abbé Ducrost: *Revue des questions scientifiques*, janvier 1882.—*Archives du Musée de Lyon*, vol. i., 1872.—Piette: *L'Anthropologie*, vii. p. 129; viii. p. 166.—H. Fisher: *Anthrop.*, vii. p. 635.—D. P. Fisher: *Bulletin de la Société géologique*, vol. iv. 1876.

the fires of the Arudy cave (Basses-Pyrenees), but they were lighted with wood. The dry cold lasted no great length of time; during the second division of the Magdalanian period [1] rain and snow became frequent, causing vast inundations which brought an intermixture of muddy deposits amongst the higher beds of the cave at Gourdan (Haute-Garonne), (Piette).

C B A

FIG. 126.—Flint scrapers of the type of those found at La Madeleine. A, the chipped and worked side; B, side view; C, the plane side, which joined the core of flint. The point of the scraper answers also as a graving tool.

The dry cold caused the disappearance of the Mammoth fauna, whilst it brought in the reindeer. The temperate and humid conditions which prevailed during the end of the Magdalanian times drove the reindeer from our countries; whilst they were the cause of the formation of our peat-bogs (Piette).

The special forms of implements found at La Madeleine have a close connection with those of Solutré. But they have a more extended range; as similar types are found in Spain, almost the whole of France, Belgium, Switzerland, Bohemia, Algeria (?): even as far as Russia and Palestine these prehistoric evidences have also analogies with modern civilisation.

With the exception of some fine lance-points, the flint implements are the same as in the Solutrian time. The greater number are designed for working bone: these are saws, scrapers, awls and fine points for engraving (Fig. 126).

[1] Thus named from the cave of La Madeleine (Dordognes) explored by *Lartet and Christy*.

Unworked points of flint finished off the darts. Some of these have been found so firmly fixed in the vertebræ of reindeer that it seems natural to ask by what means of propulsion man could have driven these darts in so far. The arrows were also tipped with very sharp bone points, having a cylindrical body and forked base, or cut with a bevelled

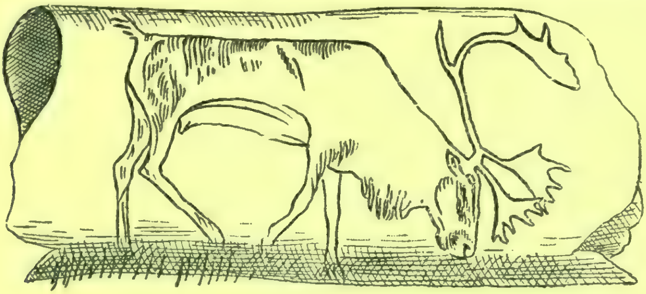


FIG. 127.—Sketch of a reindeer feeding, carved with a flint point on reindeer's horn.

edge. Amongst the other implements of this period are found bodkins, flat blades with rounded edges, poniards, etc., often artistically decorated with drawings according to the second method (Fig. 127).

Other implements in bone or deer-horns were intended for fishing: thus, for instance, a kind of needle pointed at each end reminds us of the fish-hook used in catching eels. The

FIG. 128.—Harpoon made from reindeer's horn. Laugerie-Basse (Dordogne).

harpoons are very remarkable; they resemble cylindrical arrows, the lower part is thicker than the body, and is furnished with a number of recurved barbs, sometimes on one side only, sometimes on both (Fig. 128).

A certain number of bone tools were used in the manufacture of garments; some fine needles, resembling coarse steel ones, somewhat flattened, and pierced, the eye being

well and accurately drilled, were intended for sewing (Fig. 129). Other objects, particularly some flat pieces of bone, very thin and long, with teeth like a comb, must have been used for carding stuffs (Piette). Bone discs, pierced with a central hole, no doubt answered the purpose of buttons;

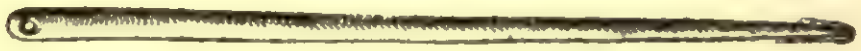


FIG. 129.—Bone needle from La Madeleine (Dordogne.)

the hole must have been fastened on by a thong or string knotted at the end.

Amongst the objects whose use remains problematical, and yet whose careful ornamentation attracts our attention, are those which Lartet calls "Bâtons de commandement,"[1] and others called throwing sticks,[2] by M. de Mortillet. These are formed of a strong piece of bone, ending in a short crook (Fig. 130). The "batons" are generally pierced with one or more holes; they are often artistically carved.

The men of the reindeer period possessed knowledge of rude drawing. The cave of Gourdan (Haute-Garonne) and

FIG. 130.—Hooked throwing-stick in reindeer's horn, ornamented with carving. Laugerie-Basse (Dordogne).

of Lortet (Hautes-Pyrénées) have furnished some examples: "on many of the better engravings, certain marks can be traced which are either the signature of the artist, or the

[1] These "bâtons de commandement" have their analogy amongst the Esquimaux, where something similar is used for the magic drum. M. Pigarini and M. Piette suppose them to be pieces of armour.

[2] The throwing stick, with a tooth at the end, is an implement with which the Esquimaux, the Australians, and some of the people of the equator, give an additional impetus to their spears and harpoons after they have left the hand. The spears hurled in this manner acquire a great additional force, and are thrown a much longer distance; the precision with which they hit their mark is truly remarkable. (A. de Mortillet, *Revue mens. de l'Ecole d'Anthrop.*, i., 1891, p. 242.)

mark of the owner" (Piette). These characters are sometimes isolated, sometimes joined to others. Some drawings, which have been most carefully executed, do not represent any special object, but are engraved spirals, dotted circles, or radiating lines and crosses: do these represent symbols, or merely fantastic ornaments?

Sometimes man ornamented the walls of the caves in which he lived with representations of animals; for instance, the cave of Pair-non-Pair (Gironde) and that of Mouthe

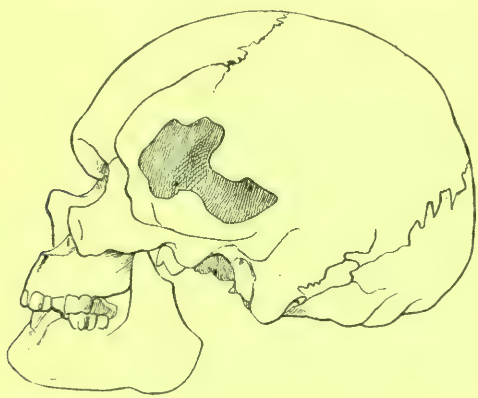


FIG. 131.—A skull from Laugerie-Basse (Dordogne).

(Dordogne). He also embellished them with rough paintings in ochre. The frequency with which peroxide of iron was found in the strata, led to the belief that man tatooed himself.

Shells of living species and fossil shells were much in use, many were found on the skeleton of Laugerie-Basse (Dordogne) on the chest, at the elbows, knees and feet. They were brought from the Mediterranean; but the greater number of the shells of the caves of Dordogne come from the western sea-coast and the drift of Anjou and Touraine.

The commercial relations at Mas d'Azil and Gourdan are the same as at the Solutrian period.

The manner of life had not perceptibly changed; without ceasing to be a hunter, man gave himself up to fishing in a greater degree than before.

As yet, there is nothing to indicate special rites of burial or religion, at least there is no undoubted fact which is susceptible of this interpretation.

The physical state of the Magdalanian man is better known. The skeleton of Laugerie-Basse was discovered in 1872 at the foot of a rocky escarpment on the right bank of the Vizère (Fig. 131). It was found under a fallen mass of

FIG. 132.—Skull from Chancelade (Dordogne).

rock, the insterstices of which had been filled with Magdalanian deposits of more than a metre in thickness. The fall of the rock had killed the man, as his spine had been crushed by the mass of rock.

At Raymunden, near Chancelade (Dordogne) (Fig. 132) a skeleton was found in 1888 in a cave, a little above the level of a small adjacent water course, it was at a depth of $1^{m}65$ ($5\frac{1}{4}$ feet) in the natural soil, which was covered up with layers of refuse and alluvial deposits (Hardy). The man whose remains were found in these beds, was lying in alluvial mud deposited after a flood; the skull was full of it.

From the examination of these skeletons and from many

other less important remains,[1] we are able to deduce the type of the man of this period. The supraciliary arches are not very prominent, the facial bones are high and broad, the outline of the forehead is straight in the front, then is gradually rounded to the summit, and the top of the skull instead of being flat as with the Mousterian race, as seen at Neanderthal, is vaulted; the orbits are deep, the nose straight and long; the lower jaw is very powerful; the molars increase in size from the front to the back, the chin is very prominent, the horizontal branch of the lower jaw makes a decided divergence, unlike those of Neanderthal type which tend towards parallel lines. The general form of the skull remains dolichocephalic as with the Mousterian races; this lengthening of the skull from the front to the back is especially noticeable in that of Chancelade. The cranial capacity is very considerable: 1710^{cc}.

There are many points in common with the Neanderthal race. The height is practically the same, perhaps a little less (Laugerie $1^{m}649$, Chancelade $1^{m}592$). They were short men with powerful muscles, as is proved by the muscular impressions on the thick boney frame. Like the Mousterian races the Magdalanian men had slightly curved legs and very prominent knees when standing. The lower members differed somewhat; the tibias are flat in the Magdalanian races; the fibulas, which are stronger, wider and more angular than those of living man, have a very marked longitudinal furrow, almost like a little channel. M. de Mortillet thinks that legs thus shaped indicate a good runner.

As the physical characteristics and the same handicrafts, have been found in a modified degree amongst the Esquimaux, it has been asked whether some of the Solutrian and Mag-

[1] These remains are those found at Eyzies, la Madeleine, (Dordogne) de Bruniquel (Tarn-et-Garonne), de Rochebertier (Charente), de Gourdan (Haute-Garonne). We are not now alluding to the skeletons of Cro-Magnon (Dordogne) nor of Mentone (Alpes-Maritimes), since they belong to a previous epoch; M. de Quatrefages took the Cro-Magnon skeleton as the type of the Magdalanian man.

dalanian population can have followed the larger mammals and the reindeers as they retreated to the north-east.[1]

6. *The Transitional Fauna.*

VARIOUS HANDICRAFTS.

The great humidity which supervened at the end of the Magdalanian epoch, drove the reindeer from our countries, and brought about an equable temperature over the whole of France. We owe the existence of the peat bogs to its influence.

Implements of the types found at Mas d'Azil.—The migration of the reindeer led to great changes in the manufacture of implements. The grain of the reindeer's horn is very close, the cortical position is compact and very thick; it was also an excellent substance for the manufacture of arrows, harpoons and works of art. The reindeer having left, man had recourse to stag's horn, an animal which had become quite common. But stag's horn is porous; the external part which alone can be used is very thin. The harpoon, which when

[1] Books on the Magdalanian period.—M. Lartet and Mr Christy: *Reliquiæ Aquitanicæ.*—Piette: *Phases successives de la civilisation pendant l'âge du renne*, Assoc. franç. pour l'av. des Sc., 20th Sept. 1892; *Classification des harpons*, Anth. vi. p. 283; *Spirales paléolithiques*, Anth. vii. 690; *Notes pour servir à l'histoire de l'art primitif*, Anth. v. avril 1894; *La grotte de Gourdan*, Bull. Soc. Anth. 18 avril 1873; *Mas d'Azil*, Anth. vi. 3. vii. 1., —Cartailhac: *Squelette de Laugerie-Basse*, Materiaux, 2e serie, vii. p. 224.—Hardy: *Abris sous roche de Reymunden, près Chancelade*, Académie des Sc., 17th Dec. 1888.—Daleau: *Les gravures sur rocher de la caverne Pair-non-Pair*, Bordeaux, 1897.—G. de Mortillet: *Grottes ornées de peintures et de gravures*, Révue mens. Ec. d'Anth., 13 janvier 1898.—A. de Mortillet: *Propulseurs à crochet modernes et préhistoriques*, Rev. mens. Ec. d'Anth., 1891, p. 241.—Mitour: *Station magdalénienne à Saint-Mihiel* (*Meuse*), Révue mens. Ec. d'Anth., 1897, iii.—Cazalès de Fondonce: *L'homme de la vallée inférieure du Gardon*, Montpellier, 1872.—Pour la Suisse: *Le Schweizerbild*, Anth., viii. p. 346.—Pour l'Espague, Grotte, *d'Altamira*, Materiaux pour servir à l'histoire de l'homme 1881.—Pour l'Algérie, *Catalogue préhistorique du dép. d'Oran par Pallary*, Assoc. franç. pour l'av. des Sc., 1891, 1893, 1896. —Pour la Palestine, *Zumoffen.*

made of reindeer's horn, was so slender, having a cylindrical staff (Figs. 133 to 136) became heavy, thick and flat when made of stag's horn. Thick implements for polishing made from the antlers of stags also replaced the pretty blades rounded at the edge, of the Magdalanian age. Art rapidly degenerated

FIGS. 133 - 136. — Various implements in reindeer's horn. A, Harpoon with barbs on one side only; B, Arrow, barbed on both sides; C, A barbed arrow; D, Needles, with the eyes well drilled.

as soon as the material which had enabled it to develope was lacking.

Thus the Azilian handicraft commenced, which owes its name to the cave of Mas d'Azil (Ariège), where M. Piette has thoroughly studied the chief strata. Indications of the same handicraft are found at Gourdan (Haute - Garonne), at

Tourasse (Haute-Garonne), and in other caves in the South of France. The pile dwellings of Switzerland, and the caverns of Oban (Scotland), produced similar weapons to those of Mas d'Azil.

The most characteristic implement is the flat barbed harpoon made of stag's horn: it is generally pierced towards the broader end with a hole; it is round at one end and very pointed, then it is cut to an oblong, and barbed. More than a thousand were found at Mas d'Azil (Fig. 137).

FIG. 137.—Harpoon made from stag's horn from the Lake-dwellings (Switzerland).

Any indication of art is only occasionally apparent.

The flint implements are of the Magdalanian form, with the exception of the little rounded scrapers.

For the first time we find small stones having the edges ground and polished, which might have served as chisels.

But the most conspicuous finds are stones coloured with ochre. They were taken from the river, and the colour, which was already prepared in a shell, or hollow pebble, applied with a little stick. The paintings are rough and inartistic. Some represent parallel lines varying from one to eight, and round spots, occasionally touching the circumference of the stone; others represent crosses, sometimes alone sometimes enclosed in a circle, dotted circles, crosses in the shape of a T, spirals, serpentine bands, ladder-like gradations, and broken lines . . . Alphabetical signs could be recognised: L, E, F, I, M; there were also the Greek letters, gamma, epsilon, iota, mu, sigma; striking resemblances with the Phœnician and Cypriote

alphabet. Undoubtedly more was intended than meaningless marks, possibly we are here confronted with a form of rudimentary writing.

M. Piette discovered two skeletons at Mas d'Azil, which had been buried after having had the flesh removed from the bones, which were then coloured red with ochre. As these bones were not in their natural position, and the smaller ones were missing, it is thought that the bodies must have previously remained sometime exposed to the air. These are the first traces of anything resembling a religious act.

Agriculture begins also to show itself. In the gravel beds of Mas d'Azil, M. Piette came upon nutshells, hazel nuts, stones of cherries and plums, acorns, perhaps some chestnuts, and a little heap of corn.

Shells used for ornaments are numerous; very few are fossils; the recent shells came from the western sea coast and the Mediterranean. The similarity of the shells used at Mentone and at Mas d'Azil tends to show that commercial relations existed between these two places.[1]

There is a similarity of funeral rites in the burials which took place at Mentone and those of Mas d'Azil: the skeletons have had the flesh removed with flints and coloured red, but often incompletely. The remains which have been found are not characteristic of the period; the worked bones resemble those of the commencement of the Neolithic time; there are no harpoons. Little triangular pieces of flint, very carefully chipped, also form a connecting link with the beginning of the Neolithic period.

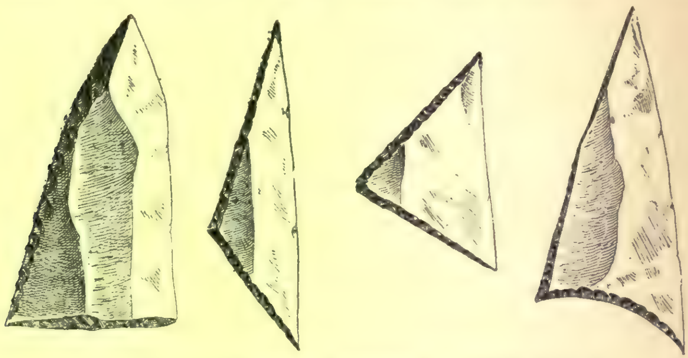
These deductions acquire still further weight, when the sepulchres of Mentone are compared with those of Cro-

[1] The Mediterranean shell which is common to these two stations is the *Cyclonassa nerites*. At Mentone shells have been found coming either from the nummulitic beds of Valognes (Manche) or the Pliocene beds at Antibes: others come from the Atlantic Ocean; another point of contact between Mentone and Mas d'Azil is the abundance of the canine teeth of the common stag, which had been strung for a necklace.

Magnon (Les Eyzies, Dordogne), where the same funeral rites, the same shells, and the same race are met with.

The shell remains.—At Mas d'Azil, the Azylian period glides imperceptibly into the polished stone age by another phase. Side by side with the flat harpoon flints of the Magdalanian shape, and the rounded scrapers, like those of the Azylian time, are found blades, chisels, and scrapers of polished stone but no hatchets.

The climate remained excessively damp, as is shown by the great number of snails of a species which only live at the present time in very damp places (*Helix nemoralis*): this



FIGS. 138-141.—Geometrically shaped flint points from the Tardenois station.

mollusc played a large share in the work of nourishment. Grindstones for corn being very numerous, it is thought that cereals formed part of the food of man. Fruit was much appreciated; acorns, nuts, walnuts, plums being in evidence. The stones of sloes are so numerous that it is probable this uneatable fruit was used to make some fermented liquor (Piette). Recent shells are the only ones used as ornaments; they come from the two seas (H. Fisher). Elsewhere the implements take other shapes. Small flints, fashioned in geometrical patterns, characterise the Tardenoisian period [1]

[1] Thus named by M. de Mortillet, as the beds are found in Fère-en-Tardenois (Aisne).

(Figs. 138 to 141). Antiquities of this time are found in France, Belgium, England, etc. (De Mortillet).

The Campignyan Archæology.—The Campignyan handiwork is thus called from the hill of Campigny, near Blangy (Seine-Inférieure), and is that of which traces are found in the most ancient of the Kjokkenmöddings[1] (Fig. 142) (kitchen refuse) in Denmark, and at the base of the peat bogs in Picardy. It was known throughout a great part of the north and west of France.

FIG. 142.—Pick from the Danish shell-mounds.

Associated with many scrapers, two characteristic implements are found: one is knife-like, the other a *pick*. In the first (Fig. 143), the edge, which has a straight and an oblique bend, is placed at the widest end of the tool. The pick is made from a nodule of flint, with large long chips on both surfaces; it ends in a point or in a bevelled edge at the extremities. The characteristic shapes of these manufactures continue to appear in the Neolithic times, even the most recent, but with a great reduction in size, and with much more careful workmanship.

Pottery abounds at Campigny, but it is coarse and badly baked: it is moulded with the hand, and bears no ornamentation.

Thanks to the grindstones found on the hearths at Campigny, we know that cereals entered into a part of the food of the people.

The human races at that time in France closely resembled

[1] After an examination of the bones found amongst the refuse of meals of man in the kitchen middens, it seems justifiable to affirm that the dog was already domesticated. No bones were left which were small enough for a dog to break and swallow. The epiphyses were all thoroughly gnawed.

the Magdalanian type. Their stature was greater, as they exceeded middle height. The man of Mentone (a specimen may be seen in the Paris Museum) is $1^{m}732$ (5 ft. 8 in.) in height. The old man of Cro-Magnon was $1^{m}71$ (5 ft. 7 in.), the adult in the same grave was only $1^{m}657$ (5 ft.), which brings him almost down to the average of the Magdalanian. The other characteristics also indicate a close relationship. The skull of the old man of Cro-Magnon (Fig. 144), which is very dolichocephalic, has an average capacity of 1590^{cc}; the

FIG. 143.—Flint axe of Campigny.

FIG. 144.—A skull from Cro-magnon.

forehead has great width, is straight and convex; the supraciliary arches are very developed, the root of the nasal bone very depressed; the orbits are wide and not proportionately high. The lower jaw is massive, and the chin prominent. The tibias are flat, and the fibulas resemble those of the Magdalanian epoch. The boney framework is very strong. The woman of Cro-Magnon has a wide pelvis. In short, the men that inhabited France were tall of stature, and endowed with intelligence and a vigorous constitution superior to the average of the present day.[1]

[1] Books on the Antiquities of Mas d'Azil and the Shell Period.—Piette: *Classification des harpons*, Anth. vi. p. 283; *Galets coloriés du Mas d'Azil*, Anth. vii. 4, p. 635; *Plantes cultivées du Mas d'Azil*, Anth. vii. 1, p. 129.—H. Fisher: *Coquilles de la grotte du Mas d'Azil*, Anth. vii. 6, p. 635.—Sur la Tourasse. Harlé. Anth. v. p. 402.—D'Arbas, 1892, p. 742.—Cartailhac, Anth. vii. p. 309.—Grotte de S. Lizier (Ariège), M. Regnault.—Grotte de Reilhac (Lot). Boule et Cartailhac.—In Scotland, Boule: *Les cavernes d'Oban*,

7. *Fauna of the Present Time.*

A. POLISHED STONE OR NEOLITHIC IMPLEMENTS OF THE TYPE OF THOSE FOUND IN THE LAKE OF ROBENHAUSEN.

After a short period of great humidity, during which time the peat bogs were formed, the climate and the fauna became very much what they now are.

A complete revolution, both social and religious, took place. Already in the preceding period, it was possible to recognise signs foreshadowing this event, which was caused by the invasion of Europe and France of new races from the East.

The rubbed stone hatchet (Fig. 145) is the typical implement of this epoch. The dimensions vary from 0.14^{c} to 0.50^{c}. Many different materials are used for it; flint is the most common; but some made of precious stones have been noticed, such as jadeite, fibrolite, chloromelanite, etc. Rocks of a looser texture were also used. Many of the hatchets were intended for ornament rather than use.

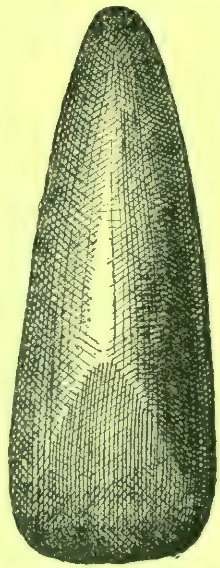


Fig. 145.—Polished stone hatchet of the Neolithic type.

When about to make a hatchet, the form was roughly made out of a piece of flint by chipping both surfaces, then finer

Anth. vii. 3, p. 319.—Grottes de Menton, Rivière: *De l'antiquité de l'homm dans les Alpes Maritimes*, 1878-88.

Antiquities of Tardenois: A. De Mortillet, *Revue mens. de l'Ecole, d'Anth.*, November 1895.

Antiquities of Campigny. Station de la Vignette (S.-et-M.): Capitan, *Revue mens. de l'Ecole d'Anth.*, Juillet 1897.

Sur les Kjœkkenmeddings. Marlat, *Soc. vaudoise des Sc. nat.* 1859-1860. Comptes rendus du Congrès international d'Anth. et d'Arch. préhistorique de Copenhagen, 1869, pp. 133-160.

working gave it its definite form. Thus prepared, the hatchet was subsequently rubbed on a silicious sandstone. In order to hasten the process, wet sand was inserted between the hatchet and the polishing stone. The friction produced on

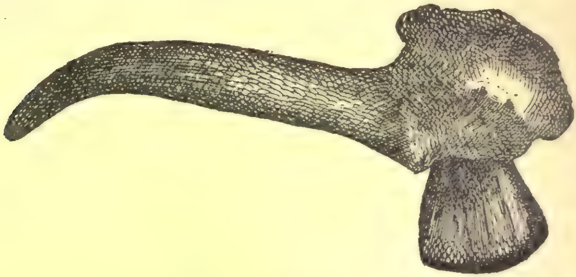


FIG. 146.—Stone axe mounted in a handle of stag's horn (Lake-dwelling of Concise).

the polishing stone many grooves more or less deep. Generally the polishing stone was portable; but sometimes it was fixed to the ground and was many cubic metres in size.

The stone hatchets were fixed into handles (Fig. 146). The projecting part was placed in a case or socket of stag's horn, fitted into a wooden handle. Towards the end of the Neolithic times, the hammer-like hatchet often had a hole drilled through it, into which the handle could be fixed: it was pierced by means of a cylinder of bone or horn by very

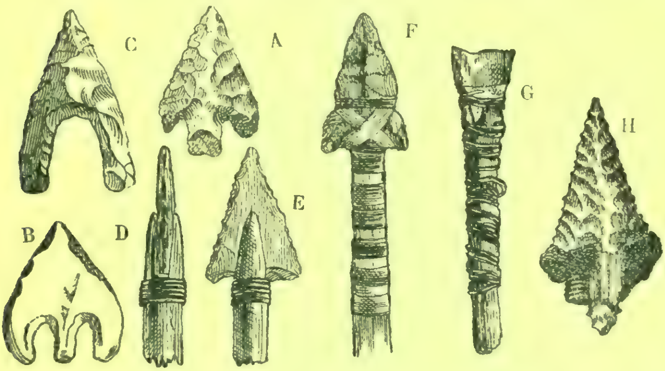
FIG. 147.—Flint Dagger.

rapid rotation, which with the help of wet sand bored circular holes.

The polishing process was also applied to long narrow chisels, graving tools, awls and various scrapers, knives, lance heads, daggers, etc.

At this period, the points of these lances and poniards are of a wonderful variety, especially in Denmark (Fig. 147). The arrow-heads at times resemble the types found at Solutré; but generally they are smaller; they are stemmed and have wings, or lateral barbs. The arrows were shot with a bow of yew, of which specimens have been found in the lake-dwellings. Another arrow-head, very frequently found at the end of the Neolithic times, has a knife-like edge, similar to those found at the hill of Campigny (Figs. 148 to 155).

The implements made of bone and stag's horn are in less



FIGS. 148-155.—Flint Arrow-heads. A and B, with wings and stem. C, with wings but no stem. D, E, Arrow-head in shaft, side and front view, found in a peaty marsh in Switzerland. F, Arrow-head in shaft, from North America. G, Chisel-shaped arrow-head in shaft. H, Arrow-head fixed with bitumen, from a Swiss Lake-dwelling.

variety; besides the sockets of the hatchets, there are bodkins, polishers, chisels, picks, fish-hooks (Fig. 156).

The manner in which the Neolithic men sought for and worked the hard stone is very remarkable. Perfect wells were dug in the chalk in order to reach the layers of flint (Mur de Barrez, Aveyron). The large blocks of flint, previously quarried, furnished numerous and beautiful flakes of flint about 40^c (15 in.) in length, which were exported and

exchanged. In this way flint flakes of Grand Pressigny (Indre-et-Loire) were discovered in all parts of France, and even in Switzerland, at Robenhausen for instance. The large cores known by the peasants as "*livres de beurre*" were either left untouched, or worked and polished so as to form hatchets.

Pottery, which was moulded by the hand and very imperfectly baked, was much in use; the bowls were often of very large dimensions; geometrical drawings displaying good taste, formed the ornamentation.

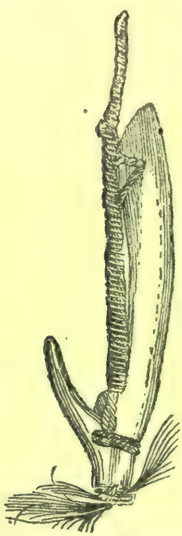


FIG. 156.—A Fish-hook of the present day (South-Sea).

Although not an artistic race the Neolithic men did not disdain necklaces and breast ornaments; for these purposes they used the teeth of animals, recent shells, either entire or cut out; and precious stones such as Callais (a kind of turquoise) and jadeite.

They wore garments of linen and hemp and made fishing nets. But the rearing of cattle and cultivation of the ground were their chief employment. The dog, ox, horse, pig and goat were domesticated; corn and millet, various oleaginous plants, the apple tree, walnut tree and the raspberry bush were all cultivated. It is probable that a fermented liquor was made from the raspberries, since the seeds are found in great quantities in the lake-dwellings as if they had been compressed to extract the juice.

In becoming an agriculturist, man had necessarily a fixed dwelling-place, and he had to defend his property against encroachment of other men. For this reason Neolithic men showed warlike tendencies, banding themselves into clans, and endeavouring to make the entrance to their habitations a matter of great difficulty. To accomplish this, they con-

structed their camps on high ground, such as Catenoy (Oise) or they raised dwellings on piles over lakes, called palafittes or lake-dwellings (Fig. 157). The methods used for constructing these habitations on the water, were very ingenious; a certain number of piles were sunk perpendicularly into the mud, each being securely fixed by piling a heap of stones at their base; then others were placed horizontally, and made firm by large stones; in the interstices more perpendicular piles were inserted, afterwards a platform was raised above

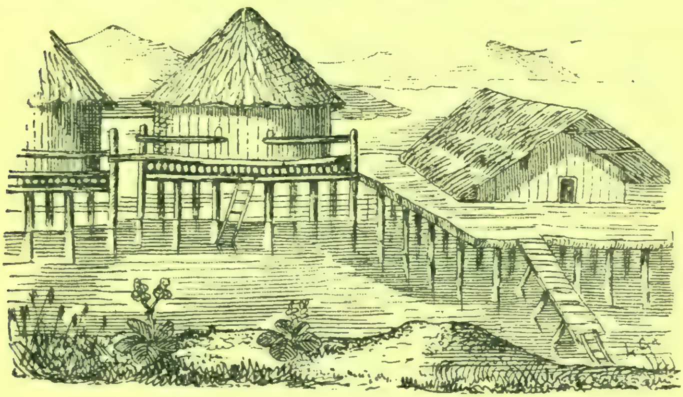


FIG. 157.—An ancient Lake-dwelling in Switzerland, restored after the fashion of the present Palafittes of New Guinea.

them covered in with a roof; communication with the bank being arranged either by means of a narrow foot-bridge or of a light boat.

Neolithic man had great respect for the dead: after a first burial, when the flesh had entirely disappeared, the bones were carried into an ossuary. The dolmens[1] (Fig. 158) and passage graves were built with this object in view; and sepulchral caverns were dug for this purpose. The skeletons are generally incomplete and the bones have not their natural

[1] Similar monuments have been met with in South America, the Indies, Syria, Palestine, in the Caucasus, the Crimea, Sweden, England, Spain, Corsica, Algeria, Cyprus, etc.; some are now being built in Madagascar.

connection. Often they are confusedly mixed, only the skulls[1] were arranged in an orderly manner in the centre of the ossuary.

If we know all concerning the purposes of the dolmens the same cannot be said of the menhirs or standing-stones (Fig. 159). When they are isolated they are probably commemorative monuments or boundaries of frontiers. Perhaps at their base the first burial took place before the bones were finally deposited in a dolmen. But sometimes they are found in long rows, as at Carnac (Morbihan), or in

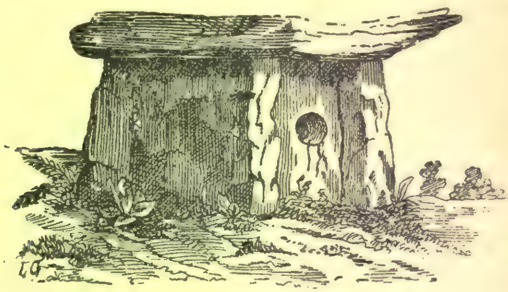


FIG. 158.—A Dolmen.

circles (cromlechs); in those cases it is not possible to guess at their meaning.

Neolithic art only manifests itself in Megalithic monuments. The cupolas, serpentine bands, naviform designs, concentric curves, strange scrolls, hatchets with and without handles, large female figures (caves in the valley of Petit-Morin, Marne), all these at times are found on the stones of the dolmens, the menhirs, and the walls of the sepulchral caves.

The modifications which intervened in the social and religious condition of the European population were caused by the invasion of a new brachycephalic (or broad head) race

[1] There prevailed in some cases a strange custom, which perhaps had a religious origin, namely, that of trepanning, or the removal of a small portion of the bone of the skull; sometimes this was done during life, at others after death. The operation was performed with a flint saw. The fragments of the skull have been worn as amulets.

(Figs. 160 and 161.) They allied themselves with the dolicho-cephalic aborigines, producing mixed breeds. In the cave of

FIG. 159.—A Menhir, found at Croisic (Loire-Inferieure).

l'Homme Mort (Lozère), out of 19 skulls 17 were dolicho-cephalic, 2 only were mesaticephalic, and showed the in-

FIGS. 160, 161.—B, Dolichocephalic; A, Brachycephalic.

fluence of the new race. The long bones also betrayed their descent, the tibias and fibulas were not flat like those belonging to the race of men found at La Madeleine; the

femur and humerus have not such deep muscular impressions, though they are well marked.

The burial places of Baumes-chaudes, which belong to the end of the Neolithic period, and in which we already find some metal objects, furnish us with 688 skulls; out of these 397 are dolichocephalic, 146 brachycephalic, and 145 intermediate. The height is 1^m61 (5 feet). The forehead is not very wide, the sutures are not deeply serrated, but the cranial capacity is great. The sepulchral caves of Petit-Morin (Marne), which also belong to the end of the Neolithic epoch, give us 44 skulls; out of these 15 are dolichocephalic, 12 brachycephalic, and 17 intermediate; the average cranial capacity is 1535^{cc} for the males and 1407^{cc} for the females. The characteristics of the race of men found at La Madeleine are therefore approximately allied to those who followed them.

The Neolithic type of civilisation, or that which is similar to it, exists now in the greater number of the Oceanic Islands.

America, the whole of Europe, the north of Africa (Algeria and Egypt), Palestine, Asia Minor, the Indies, Indo-China, or further India and Japan, etc., have all known the Neolithic civilisation.[1]

B. METALS.

1. *Copper Age.*—Man could only have recourse to those metals which he found in a natural state. Only three metals

[1] Books on this period.—For America: de Nadaillac, *l'Amérique préhistorique*, 1883, Paris; *The Cliff Dwellers*, Review of Scientific Questions, October 1896.—For France: Du Chatellier, *La Poterie aux époques préhistorique et gauloise en Armorique*, Paris, 1897.—Salmon, *Ethnologie préhistorique: dénombrement et types des crânes néolithiques en Gaule*, Paris, Alcan, 1896.—G. de Mortillet: *Boissons fermentées, Revue mensuelle de l'Ecole d'Anth.*, 15th September 1897.—In Égypt, de Morgan and Sal. Reinach.—In Sicily, Patroni, *Anth.* viii. p. 129.—In Indo-China, Mission Pavie, *Anth.* vii. p. 556; see Dr Capitan's collection.—In Phœnicia and Syria: Abbé Moulier, *La Nature*, 25th July 1897, *Anth.* vii. p. 571.—Zumoffen, *l'Age de pierre en Phénicie*, *Anth.* viii. 4.—In Russia: *Anth.* vii. p. 64, p. 345, p. 730.

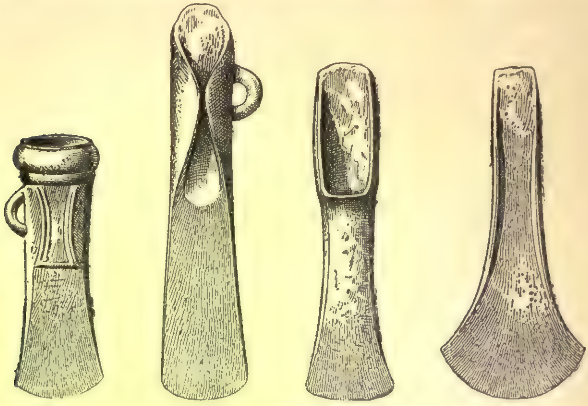
commonly exist in this condition: gold, silver, and copper. Gold and silver being comparatively rare, man used copper by preference.

Still, correctly speaking, the copper age was unknown in Europe. Bronze, an alloy of copper and tin, was the first metal used. In America, where pure copper is very abundant, its use preceded that of bronze. It is true that in Europe at a certain period there seem to be indications that the use of copper was predominant, but this fact must not lead us astray; the objects in which copper prevails also retain traces of bronze. The reason is that sometimes a lack of tin was caused by an interruption of the commerce with the East, pure copper was smelted with a smaller portion of the old alloy.

2. *The Bronze Age.*—Bronze made its way into Europe at the end of the Neolithic epoch, while polished stone was still in use. It was imported by the traders from the East. Two reasons will suffice to prove the eastern origin of bronze. (1) The use of bronze must have commenced there when copper and tin were both within reach of man. Now if copper is everywhere present, either in a pure state or as a mineral, tin is rare: the layers of tin are very few and far between in the West, whereas they abound in the East. The smelters, bringing with them a small quantity of tin, would then find the copper on the spot, and add it in the proportion of 9/10 in making the alloy. From their first appearance in the West they were in a position to manufacture a very pure bronze. (2) In the early bronze age the handles of the swords and the bracelets are such as to require very narrow hands, and bones of the forearms which are little developed. Neolithic man in Europe was however very robust, therefore these implements and ornaments must have been made for an Indian race.

The gradual intercourse of Oriental merchants with the old Neolithic races, produced a social and religious revolution, without affecting ethnic characteristics.

As bronze gradually superseded stone, hatchets were formed, which were at the same time useful tools and terribly



FIGS. 162-165.—Bronze hatchets. A, With straight sides ; B, With ridge or shoulder ; C Winged ; D, With socket.

effective weapons. M. de Mortillet distinguishes two epochs in the bronze age according to the shape of the hatchets (Figs. 162 to 165), the Morgian (from the finds at Morges) or early bronze age, in which the hatchets have straight sides, and then those with a shoulder or stop-ridge; and the late bronze age, when hatchets with rings and those with sockets follow. Ornamented statuettes, rods with movable rings or rattles (Fig. 166), bracelets, necklaces, chisels, knives, razors, needles, fish-hooks, harpoons, various weapons, utensils. etc.; these are the chief objects amongst the finds.

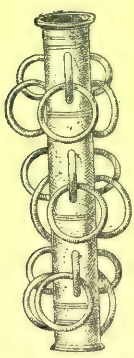


FIG. 166. — Rattle of bronze, from the Palafitte of the Lake of Bourget (Savoy).

An important change takes place with regard to the treatment of the dead: cremation supersedes the two-fold burial of the Neolithic times; this custom spreads so rapidly, that it is thought the smelters of bronze must have been religious

missionaries, who zealously propagated a new rite. The older population, however, partly resisted this propaganda, since in the tumuli in the south of France, as well as in Brittany and on the Alps, the interments in the caves and dolmens took place side by side with cremation.

From an ethnical point of view the modifications were imperceptible. Although cremation has deprived us of many anthropological records, yet enough remains to prove conclusively that the European type remained the same. The families of small hands and thin slender arms became absorbed in the aborigines; this fact shows that bronze was imported by a small number of foreign traders. They were so few that they had great difficulty in defending their lives and their riches. More often they inhabited the lake-dwellings: their habitations on *terra firma* were few and difficult of access. In order to guard their treasures (both the raw material and that manufactured) they were hidden away in holes: M. de Mortillet has discovered as many as five hundred of them in the sixty-eight departments of France.

3. *The Iron Age.*—Iron has in all probability come to us from Egypt. The first monuments of Egypt, which date back to nearly 5000 years B.C., lead us to suppose that iron was already known. As steel it must have been used in sculpturing the fine Egyptian statues, which were of a species of granite porphyry. It was also found in its natural condition, in the most ancient of the pyramids, though in small quantities. From the fact of its rusting, it was considered impure and consequently somewhat slighted.

Iron mines are very common in Egypt and in the whole of Africa. After the stone age, hatchets were always made of ironstone; as this is easily melted by fire, the accidental fall of a hatchet into the fire might have at an early date taught the Africans the metallurgy of iron. Moreover, the iron age succeeded that of stone without the interposition of bronze in all the African countries.

It was towards the seventeenth century B.C. that the

Etruscans and men of Sardes, whilst at war with the Egyptians, became acquainted with iron and carried the use of it into Italy. The commercial relations from that time established between France and Italy soon brought the knowledge of iron to us. Towards the end of the fourteenth century B.C. some Swiss founders inlaid iron as an ornament in beautiful bronze bracelets; it was not long before the new metal became common.

M. de Mortillet divides the iron age into two epochs: the Hallstadtian, and the Marnian; *the Hallstadtian* takes its name from the salt mines of Hallstadt in Austria. The explorations, carried on in the ancient cemetery of Hallstadt, show that there was a commercial centre there of great activity between the south and the north of Europe; amber was sought on the shores of the Baltic, and the North Sea. The itinerary of the traders can be traced on the map of Europe by the remains—knives, vessels, amber and coral—which they left on their passage. The Marnian epoch, thus named from the cemeteries of Marne, takes us to the fourth century B.C. From the moment that the ancient coins make their appearance clearly dated, we enter the domain of history.[1]

We have treated at some length the facts revealed by researches made in prehistoric times. It now remains to interpret them. Has man through the course of ages always been identical? Whether we take the physical point of view, the intellectual, industrial, social, or religious; he has evidently passed through many varying phases which mark evolution and progress. But this progress has not changed his nature. Always fundamentally the same, as he advances, man but adds to the force and powers of his faculties.

[1] *Cf.* de Mortillet, *Formation de la nation française*, pp. 253-273. The author gives the name *Protohistoric* to the times which have elapsed since the appearance of metals to the first historical monument. We shall content ourselves with pointing out this interesting chapter to the reader.

§ 3. *Identity of the physical type of man through the course of ages.*

It is not to be expected that from the organic point of view man should have undergone no change. We know that the human species has been in existence for some time. Whilst animals submitted to the agency of external conditions, man also was sufficiently plastic to feel something of the same influences. His environments have varied in time as in space: in time—for since the commencement of the Quaternary epoch to the present day, the physical conditions have varied several times in the same place; in space—for man, though starting from a single central point of creation, has peopled the whole world and must have accommodated himself to climates the most various.

Moreover, the human species indicates to-day many very distinct races, which can be traced back to four fundamental types: the white man, the yellow, the dark, and the red. The modifications which we now, at any given moment, find so distinctly made, might in the course of ages acquire successive gradations by evolution from a primitive type. Therefore, when we are concerned with the organic identity of man, this word must not be taken in the absolute sense. It is a relative identity, which excludes deeply seated modifications, but admits accidental or superficial ones.

Here we are confronted with a difficulty. What rule will serve us to distinguish the purely accidental or superficial changes from those which affect the human race in its essence?

It is not by organic characteristics, but by psychical functions,—by the soul,—that man is distinguished in essence from animals. Thus it would seem, at first sight, as if no fixed physical characteristic could be peculiarly necessary to man. Yet the psychical faculties, which reveal the soul without being actually the work of the brain, are closely dependent on the brain. Without the aid of the brain, which presents

a profusion of images, thoughts could not be formed in the soul. A considerable portion of brain substance is indispensable: it is very generally admitted that a brain weighing less than 1000 gr. must infallibly be that of an idiot. Therefore, the cerebral development must be considered as a special characteristic of man; all other organic features are of less importance, and any variations they show must be considered as purely accidental (Figs. 167 and 168).

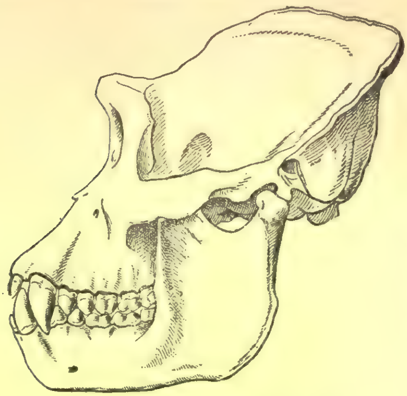


FIG. 167.—Skull of an old Gorilla.

Let us now recall the picture given above of the primitive races: men of the various types found at Moustier, La

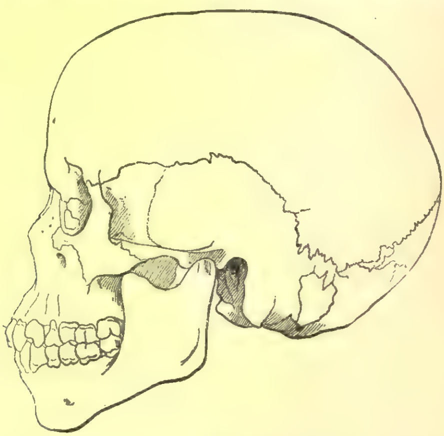


FIG. 168 —Skull of a Negrito-Papuan, from Borneo.

Madeleine, and Neolithic man. We acknowledge undoubted differences, we recognise an almost constant advance from

the primitive to the present type. But in their entirety the ancient remains of man clearly attest a structure fundamentally identical with that of man of the present day; they do not indicate an intermediary condition between the human and the Simian type; the differences between the existing races are not less great than those noticed between prehistoric man and contemporary man.

De Quatrefages, whose authority carries great weight on this subject, has made most definite declarations: "Each time that the remains have given us an opportunity of judging, we have found in him (prehistoric man) a foot or a hand which clearly indicates our species; the vertebral column showed its double curvature, to which Lawrence attached so much importance, and which Serres made the special attribute of the human kingdom as he understood it. The more the subject is studied, the more are we assured that each bone of the skeleton, from the largest to the smallest, carries in itself, in its shape and proportions, a certificate of its origin impossible to mistake."[1] Huxley said the same: "Every bone of the gorilla bears marks by which it might be distinguished from the corresponding bone of a man, and that, in the present creation at any rate, no intermediate link bridges over the gap between *Homo* and *Troglodites*. It would be no less wrong than absurd to deny the existence of this chasm." (Huxley, *Man's Place in Nature*, p. 144, 1895.)

If we admit that the organic type of the white races of the present day is the form the most advantageous to humanity, which has never been proved, it is evident that the race of men of the type found at Moustier, which was the first in order of time, would be the lowest in the order of perfection. The skull has only the average capacity of 1220^{cc}, the walls are thick, the forehead low and receding, the supraciliary ridges very pronounced, the jaws powerful and prognathous, the chin hardly perceptible, etc.

[1] De Quaterfages, *L'espèce humaine*, ch. xxv.

But of what consequence? The Mousterian race is not less positively human; it cannot be considered as an intermediary between the Human and the Simian types. In fact the cranial capacity of 1220^{cc} is more than sufficient for all intellectual operations; some very cultivated men of the white races have not reached these figures; amongst the blacks, who are men in the strict sense of the word, the average is not higher. The great development which muscles and bone had then is easily explained by the corporeal labour to which primitive man in our country had to devote himself; even in our day, are there no differences of the same kind between individuals given up to manual labour and those confined to brain work? The shape of the head, of the forehead, of the jaw, has no deeper signification; even at the present day, amongst men, we meet dolichocephali and brachycephali, high foreheads and low foreheads, prominent and receding chins, without any doubt being felt with regard to the identity of nature between the two types.

It is true that we seem able to distinguish in the past a continual progress. This progress, even if very evident, would not be surprising; it is quite natural that the physical type should become refined in the same proportion as the manners become softened and the faculties are cultivated; the effect of the reciprocal influence of body and soul is well known. But this progress is not as manifest as is supposed. If the skulls of Neanderthal and Chancelade are compared (Mousterian with Magdalanian) there is progress:

Neanderthal	1220^{cc}
Chancelade	1710^{cc}

But if the series is continued, the progress ceases:

Neanderthal	1220^{cc}
Chancelade	1710^{cc}
Neolithic	1535^{cc}
Modern	1500^{cc}

This comparison shows that during past ages, as well as at the present epoch, the average of cranial capacities has been at the same time very variable and very stable: very variable, since it can change from 1200 to 1700 without a single doubt arising as to the absolute identity of human nature: very stable, since it always circulates round the average of 1500^{cc}, and is very far from the average cranial capacity of the monkeys (500^{cc}).

The race of men of the type found at Moustier, is thus clearly shown to be human. It cannot be looked upon as the intermediary or "missing link," which evolutionists desire, to fill the gap which separates man from the monkey.

FIG. 169.—Molar teeth of the Pithecanthropus of Java.

Attempts have often been made to bridge over this gap. At one time, it was thought that the link had been found in the *Driopithecus.* In chapter iv. we showed, on the testimony of Gaudry, that this idea had been entirely renounced.

Now it is thought that it has been met with in the Pithecanthropus of Java. The discovery of M. Dubois has been so universally applauded, and so much importance has been attached to it, that we must pause for a time to examine it.

In 1894, M. Dubois, a military surgeon of Holland, published an account of the bones found at Trinil, on the Bengawan, a river in the island of Java, these remains comprise two teeth, a whole femur, and the upper portion of a skull.

The remains were found at different times. They were not together, but all in a space of about 15 metres (48 feet 9 inches.) The excavations made in the neighbourhood, yielded nothing at all approaching these four remains. The alteration in the bones shows that they are not recent; moreover, the bones of the animals associated with them, belong to extinct species, but closely resembling the present fauna of Java, and the regions near. It is thought that the strata are Pliocene.

The two teeth (Fig. 169) (second and third molars), differ

in their proportions, and the wide separation of the fangs, from similar teeth of man of the present day. The femur (Fig. 170) in every way resembles a human bone; it is much

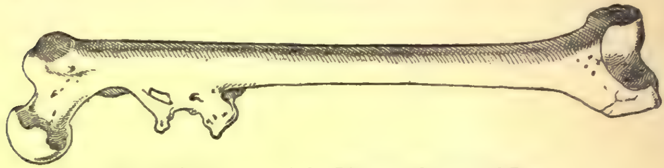


FIG. 170.—Femur of the Pithecanthropus of Java.

more slender than those of the large apes. The osseous excrescence is entirely accidental. The skull (Fig. 171) resembles that of Neanderthal; the forehead recedes, the supraciliary ridges are prominent, the type is dolichocephalic; behind the arched ridges, the depression is rather more

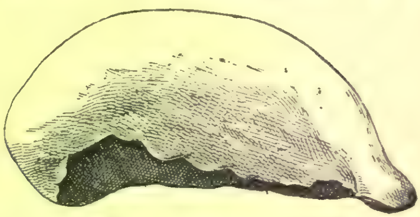


FIG. 171.—Part of skull of the Pithecanthropus, side view.

marked than in the Neanderthal skull. The cranial capacity is considered to be 1000^{cc}.

Twenty-one authors of various nationalites have expressed their opinions on these remains. M. de Mortillet[1] has tabulated them in the following manner:—

THE REMAINS	ATTRIBUTED TO MAN	INTERMEDIARY OR LINK	ATTRIBUTED TO MONKEYS
2nd molar . .	...	5	2
3rd molar . .	4	8	6
Femur . . .	13	6	1
Skull . . .	6	8	6

[1] De Mortillet, *Formation de la nation française*, p. 222.

It appears to us that these bones, however valuable and interesting they may be in themselves, do not enable us to lay down any scientific basis whatever. In fact (1) the epoch to which they belong is not known. Neither stratigraphy nor palæontology justifies us in identifying these layers with our Pliocene. The change in the fauna since the formation of these layers does not necessarily imply that they are Pliocene, they may be only Quaternary. (2) There is nothing to prove that these remains belong to one individual, or even to individuals of the same species. They were found at such a distance from each other that they may form the subject of many hypotheses. (3) These remains form too isolated a case upon which to frame a judgment. That it is possible to assert that the characteristics belong to a Mousterian race, is due to the fact that we possess as many authentic examples which lean towards this conclusion. As for the Pithecanthropus of Java, we must await other discoveries before pronouncing; these would teach us whether a new type must be signalised, or whether this abnormal skull must be classed amongst the results of teratology. (4) Of the four bones, the skull alone can have any important significance. Its shape approaches that of Neanderthal, as can be seen by comparing the engravings; it is far removed from that of monkeys. The capacity which is alleged to be 1000, is evidently abnormal. No monkey has ever approached this figure; man sometimes descends to it, but only in degenerate individuals. For these various reasons, we therefore consider the conclusion to which M. de Mortillet has arrived as very premature, he looks upon the *Pithecanthropus erectus* of Java as man's precursor, and that con-

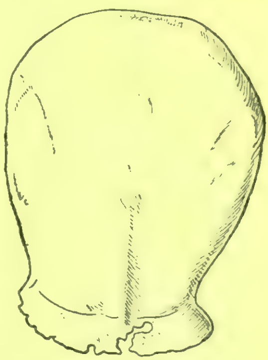


FIG. 172.—Part of skull of the Pithecanthropus, seen from above.

sequently the human species had its origin in the south-west of Asia.

§ 4. *The Intellect of Primitive Man.*

To have discovered that the human organism, with the exception of slight variations, has remained identically the same from prehistoric times, is a great point gained. But it is of much greater importance to be able to assert that the human mind was, from the beginning, such as it is now. The special characteristic of man is his mind, and we should recognise that man had always been his own true self, if it could be proved that he had always possessed the same mind.

But that no misunderstanding may exist, it may be further stated that in speaking of the intellect of primitive man, we do not mean to assert that he possessed the same amount of science that we have, or that he had the faculties for study which manifest themselves in cultivated races; we have no desire to deny the real progress which the human species has made and the constant advance towards the possession of greater knowledge, which is so apparent in the history of civilised nations. What we seek to show is, that primitive man was evidently endowed with intellect as we are, and therefore as far removed as we are from animality.

The problem of the intellect must stand on the same ground for prehistoric man as for the peasant or the present savages. When we proved that the savage races were true members of the human family, we sought amongst them not for our scientific knowledge, not for our literary centres, nor our academies, not for the refinements of our European civilisation, not for the use of gas, electricity or steam, etc., but true marks of an intelligence,—of an intellect of the same nature as ours. Of two sons of a peasant, one might devote himself to study and become an academician, whilst the other might not be able to read or write, and would pass his days in tilling the land; nevertheless it would be possible for the second to surpass the first in intelligence: and in spite of the

unequal devolopment, and granted also the unequal power of the intellect, there would still exist an identity of nature between the two minds. In the same way, if comparison be made between a learned European and a primitive or modern savage, the point in question would not rest on a difference of development or even on worth, but on the proof of the existence, on the one side and on the other, of a mind, an intellect, of the same nature.

The process which would serve to demonstrate the existence of the human intellect in the uncultivated peasant, or the ignorant savage, should suffice also to prove the existence of the same intellect in the Quaternary races, of which the sorry remains remind us naturally of a savage condition.

What measures do we take to discover human intellect in the savage or the peasant? We hold intercourse with him, we listen to his language; we strive to educate him, and find him susceptible of an intellectual development comparable to our own, as he can absorb our ideas and our science; we note his acts, his handicrafts, his works of art, and we find in his labours signs of imagination, of powers of reasoning, and even of invention. All this seems so different from what we find even in the best endowed animals, so similar to what we observe in civilized man, that we may conclude without hesitation that the peasant and the savage, though left to their natural powers, show themselves as distinctly to be men as we do, and are separated from animality by as wide a breach.

When it becomes a question of prehistoric man, we must acknowledge that we are less rich in evidence; but what we possess is of such a nature that we are logically led to the same conclusion. We cannot interrogate him in order to be able to assert that he possesses articulate language: but by what right do we refuse him the gift of speech? Since his handiworks show him to have been at least equal to the modern savage why should he not also have speech? As our generation speaks whilst working at iron and metals, why

should not the past generations have spoken whilst working stones? Doubtless the development both physical and moral which the savage undergoes is a striking proof of his intellect: but has not prehistoric man also undergone development as we have descended from him? Whilst in us he has arrived at a remarkable degree of scientific knowledge, have not his contemporaries, the monkeys, remained absolutely illiterate and without signs of progress in their descendants?

However legitimate these inductions may be, they have not the same weight as direct proof. These proofs must be sought for amongst the labours and arts of prehistoric men. They have bequeathed their weapons, their implements in stone and bone, their works of art, their pottery, their funeral monuments, etc., etc. . . . In all these objects, as in so many books, they have written in very legible characters, what is the nature and even the force of their intellect.

The remains left to us of their handicrafts, show us that they were at least as advanced as the modern savages: for what would be left of the Fuegians, the Australians, the Mincopies, etc., but implements of stone, arrows, hatchets and harpoons, similar to those which have been found at Saint Acheul, Chelles, Moustier, Solutré and La Madeleine? There was at least as much intellect in our Quaternary ancestors as in those races who still work in stone.

Moreover, the Quaternary weapons and implements are always attributed by the anthropologists to men resembling ourselves. In the cases where the flint flakes bear no evident trace of the result of intelligent action, they are attributed to the mechanical forces of nature; but when there are signs of intentional shaping, the surface of fracture, the bulb of percussion, the retouched edges, all these indicate the action of intelligent man. These examinations, carried out before any discussion arose, show that the anthropologists start with the principle that, from all time, man has been characterised by the intelligence which manifests itself in his work.

It is quite sufficient to examine the most ancient implements to discover signs of intellect; of a faculty which conceives, reasons, foresees, confines, and oversteps the immediate needs of the work. For monkeys to defend themselves by blows with the fist or even to pick up a stone in order to hit their enemy, is a phenomenon that can be referred to the senses as its cause, from the simple association of images. But when a living being takes this pebble with the deliberate purpose of making it into a weapon of definite shape, that is what no animal has ever done, and is what man has known how to accomplish from prehistoric times.

This was only possible for man because he was endowed with an intellect capable of abstraction and of invention. Many acts of intelligence were necessary only to prepare the hatchets found at Chelles, which were the first and most elementary of the human implements; there was first the thought that a pointed shape given to the natural stone would render the weapon more effective, the likeness of the hatchet had first to be imagined before it could be realised, the points presenting the least resistance had then to be chosen, the direction and force of the blow to be given, had to be calculated, etc., etc. There was in fact a whole art which could not be found out all at once; but the very fact of one generation of men knowing how to profit by the progress acquired by the preceding one, is in itself a sign indicative of intelligence. If all the works of primitive man were analysed, in all the same traces of intellect would be found.

It has been very justly remarked that these prehistoric men must have possessed great intellectual power, since they were able to create—to invent—their implements. Euclid did not go far in geometry, but in creating his fundamental theorems, he made proof of his genius. In the same way he who invents the lever or the screw, etc., has an inventive faculty which surpasses in value the power which

puts together the constituent parts of a locomotive. The same may be said of those who invented the flint hatchet, or the art of hitting the nucleus of flint in the way best calculated to strike off the knife-like flakes, or of making the handles for the tools, and the first arrows: the Quaternary men were the true creators of our modern handicraft. How then can we refuse to acknowledge in them a mind similar to our own?

It may be said that this refers only to Quaternary man, whose remains we have, and anthropologists deny us the right to assign those qualities which we find in them, to primitive man. They say in effect, the man whose works you show us was already very advanced in civilisation; but before manufacturing the Chellian hatchet, during how many centuries had he not undergone the process of evolution, using in the meantime only the uncut flakes and the unhewn stones? He was man then: it is previous to that that his evolution must be placed, and that his slow passage from the Simian condition to that of a man must be traced.

This hypothesis, in which evolutionists must perforce take refuge, is not only gratuitous but is also contrary to sound scientific data. It seems reasonable that if we go back from the Quaternary man of our countries to primitive man, to the first father of the human race, we should, on scientific grounds, suppose that he also was endowed with an intellect of the same nature as ours, and as powerful.

In fact, we should not seek for primitive man at a great distance from our Quaternary ancestors. If we had come upon the remains of the human body, long before seeing traces of his work, then we might have asked if man did not live very many centuries before making tools and weapons: but, on the contrary, the implements of man are more ancient than the remains found of his skeleton. The Chellian antiquities can be undoubtedly traced to the beginning of the Glacial period: but the remains of the human body belong at the most to the Mammoth age. How is it that

man, having lived for so many centuries, even in Europe, was so little scattered that no bones have been preserved before the Chellian period, and that even at the Chellian period, when we find the first evidences of his handiwork, we see no traces of his body? Is it not better to admit that man made his first appearance in France in the Glacial period, that he wandered in troops by the banks of rivers, where he let fall his tools? Would not a small number of centuries suffice for the human family which was created in Asia, to multiply, and to extend itself over Europe? To have found man intelligent and industrious so near to his beginning, is surely to have the right to conclude that he was so from his creation?

§ 5. *The Religion of Primitive Man.*

Certain philosophers would be inclined to conclude from what has been said that primitive man experienced religious feelings and practised religious duties. As soon as his intelligence awoke, primitive man must have been led by the grand spectacle of nature, ever before him, towards thoughts of causality, in other words, towards God, and by the consciousness of his own intellectual acts and free will must have drawn conclusive evidence of the spirituality and immortality of his soul; from this germ of knowledge of God and of himself he must have conceived the necessity of worship directed towards his Creator.

This argument no doubt has weight, but only with those who admit the perfect identity of man during the course of ages. It is exactly this important truth which we seek to emphasise and make clear by fresh evidence; for this we shall once more have recourse to positive scientific data, in order to strengthen a conclusion partaking of a speculative nature.

But first we must be quite clear as to the meaning of the word religion. From using it in too restricted a sense, eminent

authors have treated whole nations as atheists; we think that de Quatrefages is right in saying that all men are to be considered religious who believe in two things: (1) That there are superior beings having the power to influence his destiny whether for good or evil; (2) that a part of himself will survive after death, whatever may be the condition of the existence which his imagination pictures on the other side of the tomb.

In order to try to discover in primitive man these essential foundations of religion we have three methods: to study the religious condition of present nations, to make researches in history for the most ancient evidences of religion, and to search in prehistoric times for the first manifestations of its worship.

The religious condition of races of the present day has been much discussed. Learned men whose opinions have weight, such as Livingstone, Baker, Monnat, Dalton, Bradley, Lubbock, Broca, etc., have taught us that certain tribes are entirely destitute of all notions on religion. Monnat says of the Mincopies (Andaman Islands): "They have no belief in a Supreme Being, nor in religion, nor in a future life." Sir Messenger Bradley says of a tribe of Australian aborigines: "They have no superstitions of any kind and have not the slightest notion of a future life." According to Broca, "there exists amongst the inferior races people without rites, dogmata or metaphysical ideas, without collective belief and consequently without religion."[1]

De Quatrefages to the very end never ceased to protest against these assertions. "I have searched for atheism with the greatest possible care," he says. "I have nowhere met it, except in erratic conditions, amongst some philosophical sects, belonging to those nations who were the most civilised anciently."[2] This eminent anthropologist applies himself to the task of showing how preconceptions have prevented certain

[1] *Cf.* Joly, *L'homme avant les métaux*, p. 302 *et seq.*

[2] De Quatrefages, *Introduction à l'étude des races humaines*, p. 254.

travellers and missionaries from recognising the religion of some of the races of savages: then he shows the result of a more careful study of the subject. The Mincopies (Fig. 173), for instance, who are reputed to be without religion, have in reality beliefs of a high standard. They consider man to be actuated by two principles, the mind and the soul. Both survive the death of the body, but at that moment they separate and inhabit distinct regions until the time of the future resurrection arrives. The spirit then betakes itself to a large

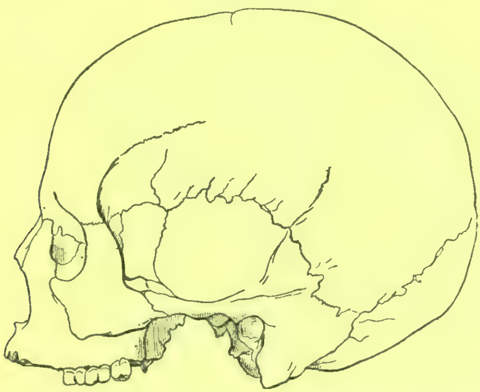


FIG. 173.—Skull of the Mincopies from the Greater Andaman Islands.

jungle which is under the earth, where it resumes all its terrestrial customs. The soul alone is judged by Pûluga, the Supreme Deity of these tribes, and, according to its merits, is admitted into an abode of delight or hurled down into icy infernal regions.[1] Such are the savages whom Monnat says have neither religion nor belief in a future life.

Without quoting more examples, which can be read in the works of de Quatrefages, we consider it to be an established fact that all human tribes possess a rudimentary form of religion. Emile Burnouf is of opinion that the most pronounced form of fetichism is itself a kind of religiosity; for

[1] De Quatrefages, *Introduction à l'étude des races humaines*, pp. 259, 260.

to be able to concentrate all the powers of the earth in a piece of wood, in a stone, in the figure of a man or an animal, proves that man had conceived of invisible and dominating powers in nature.[1]

But this universality of religion in the present has also a close bearing on the past. For, either these religious beliefs are the fruit of the human mind, or they are the common heritage of a primitive state. If it be admitted that amongst all races the human mind created religion, a very pressing necessity for it must have been felt, for it to be adopted by all: and, if even the most wretched tribes discovered and preserved it, how was it that primitive man, who was their equal, had not also found it? If it may be regarded as a common heritage of all races, then the origin of it must be sought quite at the commencement of humanity; for the human families separated at a very early period, and, as time went on, they lived in a very isolated condition, without interchanging goods and thoughts as do the people of the present day.

The most remote date which records any event of the nature of history can be fixed at the highest at five thousand years, or at the least four thousand years before the Christian era. At this period the tablets were engraved which show us that Our-Sina, a Chaldæan king, worked with his own hands at the erection of a temple to the Divinity. The earliest monuments amongst all peoples bear reference to religion. It is a remarkable and important fact, the further back we go in the history of any people whatsoever, the more we recognise the profound and wide influence of religion in the national life.

Thus history, far from instructing us in the creation and progress of religion, is chiefly concerned with telling us of the encroachments of the civil power on that of religion. Men do not give up atheism as civilisation advances, but are rather inclined to it, in the same proportion as the advance

[1] *Cf.* Joly, p. 304.

made. As the life of a people becomes lost in the shadow of the prehistoric times, everything leads us to conclude that the dominion of the religious element was paramount then. Are we not right in concluding from these observations that the beginnings of humanity must have been religious and not atheistic?

Finally, do prehistoric times furnish us with data on the religious thought of primitive man? Before giving an answer, two observations are necessary. (1) A people may have religious feelings and practices without leaving any proof of the same to posterity. When in the future, anthropologists make explorations in the Andaman Isles, they will find some skulls and some implements, but nothing to indicate that the Mincopies had elevated ideas on religion. It is the same with many other tribes. This shows us with what readiness an author might credit the primitive races with atheism, only because the signs of religion are not obvious. (2) The indications of religion which are capable of traversing long centuries are few in number. There are sepultures, and the attendant circumstances, also the objects of stone and bone analogous to amulets and the fetiches of contemporary savages.

Were the Neolithic populations of Western Europe religious? All things lead us to think so; moreover, no one doubts it. These populations were in part formed from families who had come from the East, and had brought thence the custom of polishing stone and of domesticating animals; now the Neolithic age of Europe corresponds to the time when Egypt and Chaldæa were at the height of their civilisation, and when the worship of their divinities was carried out with the greatest honours. It is not credible that the religious feelings which so abounded in Asia should not with civilisation have passed into Europe. Moreover, "the belief in another life is indicated in all the Neolithic tribes by the care bestowed on their sepulchres." These tombs were in natural caves or artificial grottos, sometimes

large dolmens; offerings to the dead are always found, "implements, vases, ornaments, and weapons which were intended to be useful to the dead in their new existence."[1]

Sepultures, showing the same care, can be traced back to the transition period, where the Neolithic joins hands with the Palæolithic epoch. Signs of religion seem to have been as conspicuous in the Cro-Magnon races as in those which were entirely Neolithic. Thus, in the burial places of Vézere, and of Mentone, objects of apparel were placed near the corpse, and all that might be useful in a future life.

It is true that nothing similar to this has been noted in the Palæolithic races. But that constitutes a negative argument only: if religion has left no recognisable trace, there is also nothing to prove that the men of Chelles and of Saint Acheul therefore had none. The absence of all indications of religion is easily explained, but the absence of all religion in primitive man would be inexplicable.[2]

This short summary is sufficient to convince us that religion in the human races existed as far back as we can reach, not merely as recorded by history, but as known by legitimate induction. It is therefore natural to admit that primitive man was himself religious, or at least it would be very illogical to deny it.

§ 6. *On the Origin of the Savage Races.*

In the arguments which we oppose, the question of savage man holds an important place. He is represented as the undeveloped portion of the human family. What he is, all men have been. In the intermediate phase, between the animal and the civilised state, man resembled the contemporary savages; we find his remains amongst the antiquities

[1] De Quatrefages, *Introduction a l'étude des races humaines*, p. 281.

[2] *Cf.* Joly, *L'homme avant les métaux*, l. ii. ch. vii., *La religion.*

of prehistoric times; whilst those races which were more advanced, on account of their organism or environments, increased and acquired civilisation, these which were less privileged remained stationary, and became faithful witnesses of the sad state through which all the race passed.

This theory is supposed to demonstrate the two following facts: (1) That primitive man was as much a savage and as low in the scale as the last of our contemporaries; (2) that the present savages are cases of arrested development, and not men who have retrograded. Now these two facts, if not entirely false, are very open to dispute; they cannot be admitted as absolute formulæ simply by being asserted.

European races are the only ones known to us of the prehistoric times. To prove that they were savages, the stone implements which they have left to us are brought forward as witnesses, as being similar to those in use by the present savages. Our opponents quote their wandering life as hunters, or as fishers, with no fixed habitations, with no traces of sepulture at the first. We must be careful not to exaggerate the savage condition of primitive man in the West. There is no doubt that at the Neolithic period man was very civilised, although he had not the knowledge of metals; at the Palæolithic period, man of the type found at La Madeleine was a good workman, artistic, and very ingenious, etc. It could only be asserted of the man of Saint Acheul that he led a wandering and wild life by the sides of the rivers.

Whatever appearance of savage life primitive man in our country may have had, their condition should be very clearly separated from that of the contemporary savage.

The men of Chelles, Saint Acheul, and Moustier were simple, possessed elementary implements, and led a wandering life; but they made progress, they acquired fresh knowledge, their conquests over nature were gradually increased. The present savage is, on the contrary, degraded, he retrogrades, he holds unconsciously and uselessly the

traces of an ancient and more advanced civilisation; without being condemned *à priori* to a complete disappearance, he will inevitably become extinct.

It is, therefore, not true to say that the modern savage is a faithful reflection of Quaternary man; he has not been merely stationary in his development, he has forfeited the higher ground on which he was. To determine the condition of the contemporary savage will be to serve the cause of Quaternary man.

1. *The savage of the present day is one who has retrograded, and* not *remained stationary.*—For this proposition to be true, it is not necessary to prove that savages have had amongst their ancestors men as well informed and as civilised as modern Europeans. It suffices, as we look back through their past history, or as we study the traces which they have preserved of the past, to show that their ancestors were better informed, more civilised—superior to themselves. We shall not pass under review all the savage tribes of modern times; but we shall mention the principal number only, at the same time feeling convinced that the same may be said of all.[1]

Australians appear to be placed on the lowest step of the human ladder: some authors going so far as to refuse him the same origin as the rest of humanity, and they look on him as a sort of intermediary between a monkey and a man. This portrait certainly is not flattering: his stature is short, his head wide, the forehead narrow and receding; the eyes are black and deeply sunk, the nose flat, the jaw prognathous, and the bones of the skull thick; his colour varies from sooty black to a red brown, and the straight hair somewhat resembles that of the white races. Their implements are very primitive: they have the stone hatchet, the lance, the assegai, and the boomerang; they have no bows nor arrows;

[1] We draw the reader's attention to the works of de Quatrefages, in which the learned author has made in some measure the genealogy of all the races. *Cf. L'espèce humaine*, *Hommes fossiles et hommes sauvages.*

for instruments of music they have a very rudimentary tambourine, and a kind of flute blown with the nose. (Dr Jousset, *Evolution*, p. 188.)

Nevertheless it is easy to see that the Australian is a man in the full meaning of the word. He possesses an articulate language of which the dictionary and grammar are copious. Social organisation is not lacking. The relations between the sexes are regulated by strict laws; the men marry out of their own clan and thus make amicable relationships with neighbouring tribes. Wars are of short duration, because peace is promptly concluded by the arbitration of the old men. Dogs are domesticated. The rites connected with the dead are reverently performed.

These unhappy people bear unequivocal traces of a more favoured condition in the past. Thus children taken at a very early age show signs of being intellectually disposed, learning foreign languages with ease: up to the age of manhood, they show themselves to be superior to their companions in the schools, as do the negroes in the United States. If we apply the laws of heredity to these cases, would it not be possible to see in these successive conditions, signs of the similar conditions which succeeded each other in the families of the ancestors themselves? According to a learned Canadian, all the Australian dialects have a perfection which is surprising: the grammar possesses seven declensions, each declension includes ten or eleven cases, more logically framed than in the Aryan languages; the verbs have conjugations, with many moods and tenses; the derivation of words is clearly arranged; the prefixes and suffixes indicate an infinite number of shades of meaning. This richness of language, which is undeniable testimony to a well-developed intelligence, exceeds both the capacity and the present needs of the Australians. Thus their language testifies to an earlier and happier condition, from which they have sadly declined.[1] We can cite many other instances proving a better state;

[1] *Cf.* de Nadaillac, *Le problème de la vie*, chap. vii.

the paintings and sculpture, amongst which has been noticed some heads surrounded with a bright nimbus, and a being clad in a red robe; extensive astronomical knowledge which enables them to tell the time with great precision; and circumcision, which was practised formerly amongst many people of an Asiatic origin.

The degradation which the Australians have evidently undergone has for its cause the unfavourable circumstances in which they have been compelled to live, always in dispute, always scantily fed, and under a tropical sky. Mr Hale asks whether in similar circumstances even an Aryan race would not also have descended to the level of the Australians.

According to Mr Hale, the Australians did not descend from the first races who peopled the globe, but from the Dravidians who inhabited Hindostan before the arrival of the Aryans. About 1500 years before the Christian era, the Aryans must have invaded Hindostan; although less advanced in civilisation than the Dravidians, they nevertheless vanquished them. Then the Dravidians, being turned out, emigrated in the direction of Oceania. In Australia they in their turn conquered the first inhabitants of this great island, and mingled their blood with that of the vanquished by intermarrying. Thus is explained the mixture of the ethnic characteristics of the white and black races amongst the Australians.

If this immigration is not absolutely proved, at least it is certain that the Australians are a decadent people, condemned to perish under the double influence of a dangerous climate, and a corrupt foreign domination.

The *Tinneh*, or Dené-Djindjié, hardly yield the palm with regard to wretchedness and decadence to the Australians. Banished to an unhealthy climate in North America, between Hudson's Bay and the peninsula of Alaska, they have great trouble to provide nourishment for themselves. An incessant cold stops almost all vegetation. When a native cannot succeed in taking the animals whose flesh he intends to eat,

he is reduced to eating the mosses and lichens which he gathers from the rocks. He has no fixed habitation as a rule, is without social organisation, only builds huts when actually driven to do it by the cold.[1] "Though egotistic, vain, and cruel towards the aged, the women, and the sick, who are useless mouths . . ., he is self-restrained, little vindictive, humane, generous even towards those from whom he has a right to expect a service" (de Nadaillac).

In spite of his wretched life the Tinneh possesses a true human intelligence, and is susceptible of training and education, and capable of progress. His language is noticeable for its "variety of expressions, the richness of its inflexions, its numerous auxiliary verbs ; in fact, all the characteristics denoting an advanced tongue." M. de Nadaillac applies to the Tinneh language the words which Max Müller used of that of the Iroquois : "The people who constructed such a language are composed of men of powerful minds." Incapable now of such force of intellect, the Tinneh, like the Australians, show themselves to be the descendants of a more cultivated race than their own.

The same can also be said of the Maories, poor savages of Chatham Island in Polynesia. At the beginning of the fifteenth century they left the island Hawai, where they had attained a certain civilisation. After two centuries and a half of isolation and misery they fell into the lowest degree of savage life ; leaving the cultivation of the soil,—which occupation had been held in great honour by their ancestors,—they became exclusively fishers and hunters.[2]

The theory of degeneration also readily explains the miserable conditions of the Fuegians, of Tierra del Fuego. Darwin places them in the lowest degree in the scale of humanity, almost lower than the best endowed animals. "Their language," he says, "can hardly be called articulate.

[1] De Nadaillac, *Le problème de la vie*, p. 276.

[2] *Cf.* Jousset, *Evolution*, p. 18 ; De Qautrefages, *Hommes fossiles et hommes sauvages.*

Captain Cook compared it with the noise made by a man in clearing his throat." Fuegians being exclusively hunters and fishers possess bows, and their arrows are tipped with points of *chipped stone.*

Have they receded to the period before polished stone, or have they remained stationary at that of worked stone? Their language and their history answer this question. According to Bove their language is so rich that it can only be the remains of an ancient civilisation: one of their dialects, the jagan, is a pure language, very complete in its grammar, having more than 30,000 words. The Fuegians are Americans of the Indo-Peruvian race, who, under the government of the Incas, constituted the most civilised nations of America. Thrown by their enemies on the barren and inhospitable rocks of Tierra del Fuego, they could not but fall from their earlier condition of civilisation. But they always remained very open to education, as was seen by the individuals of the little colony who were brought to Paris about 1881, and as the success of the missionaries to the Fuegians has always evidenced.[1]

The *Bushmen* may be cited as the most degraded men of all Africa; they are degenerate Hottentots. These, in their turn, if we follow the opinion of eminent ethnologists, are emigrant Egyptians, debased and deformed by misery.

It is useless to lengthen this enumeration. In taking the most savage races of all the continents we arrive at the same conclusion; savages are the vanquished whom misery has degenerated. We might also find striking analogous cases even amongst civilised people. Do we not see under the double influence of vice and privation savages being developed, who wander in the streets even of our large towns? It is sufficient to observe here how far all this leads us from the theory of anthropologists, who consider the savage as a belated type of the human family, as a faithful copy of the primitive stage through which all the races passed.

[1] *Cf.* Jousset, *Evolution*, p. 18; Vigouroux, *Les Livres Saints*, t. iv.

2. *On the manner in which civilised man arrived at the condition of a savage.*—No human race is, from its nature, condemned to degradation; all men, placed in favourable conditions, can progress towards civilisation. But all races do not repel with the same energy the real factors and influences of a savage state; the black races are the weakest, the white the strongest. But is not this present weakness of the black race the sad effect of a long decadence? Nor, in spite of all that has been said, is isolation a true cause of degradation. If only one family, forced by the exigencies of war or famine, were to emigrate to a spot hitherto deserted, it could establish itself there and form a civilised tribe, provided the surroundings were favourable and it had not already lost all springs of action. The difficulties of the material life are the real causes of savagery. Apart from civilised centres, set aside on unfruitful land, in constant warfare with the extremes of climate, always trying to avoid hunger, entirely absorbed by material wants, the most cultivated man would quickly become stupefied and callous under the burden of excessive fatigue and of continual privations. In those places where the soil is fertile, as in the Soudan, the negroes are agriculturalists and shepherds; they have fixed abodes; their way of living is simple but in no way savage. Whereas, in those places where the ground is barren, men are hunters, without settled habitations, without a body-politic, with no religion but a coarse and often crude fetichism, reduced to the rudimentary handicraft of worked or polished stone.

It is easily understood what a sad intellectual degradation must be in operation under such conditions. Without entirely losing all intelligence, or aptitude for instruction, the savages become children again, are idle, with a horror of anything that costs an effort, and losing that ingenuousness which belongs to civilised races. Perhaps it is less easy to grasp that the degradation affects and disfigures the physical organism itself. But so it is. The soul and the body are

in relations of such close sympathy that the decadence of the one cannot but entail that of the other.

The muscular force decreases gradually. De Quatrefages (*Hommes fossiles et hommes sauvages*, p. 325) gives us the results of Péron's researches on this subject. Putting the power of arm at one kilogramme, Péron gives 71.4 for Englishmen, 69.2 for Frenchmen, whilst he only allows 58.7 for the Timorian, 51.8 for the Australian, and 50.6 for the Tasmanian. The same difference exists in the strength of the back. De Quatrefages, however, warns us "that the conclusion must not be applied too universally," since some savages accustomed to wrestling surpass the white race in physical force.

Mortality increases. Longevity would be surprising in a savage: the irregularity of his meals, the dirt in which he lives, his powerlessness to conquer epidemics; all these things tend unceasingly to decimate the inferior races. Fecundity itself cannot but feel the effects of the rough work and the privations which the women undergo.

Without being able to establish a general law, it is a very usual fact, that a savage condition causes a diminution of the skull, a thickening of its walls, the bones of the face become more massive, so that prognathism and dolichocephalism increase gradually. By a strange reaction of influences, the lack of culture, produces a distortion of the head, and this distortion renders application and culture more difficult. This it is which forces a savage into a state of inferiority which becomes accentuated from day to day.

3. *The fate of Savages.*—It is easy from what has gone before to predict the lot of degenerated man. (1) As long as he remains under the dominion of the hard conditions which crush him, he will continue to sink and to become physically and mentally enfeebled: a victim to his enemies, and to the difficulties of his environment, his race will end in extinction. (2) But should he succeed in releasing himself from the restrictions of his poverty, should he either by his own efforts, or through

the efforts of a humane assistance, be placed in more advantageous circumstances, thus will he regain the ground he has lost; and will become capable of educating himself, and of becoming civilised; this is owing to the fact that under the marks of his degradation, humanity remains intact; always capable of great reactions. Of these two hypotheses which would be most often realized? The first certainly: since how could this enfeebled savage establish himself on fresh ground, where men stronger than himself are the controlling power? Would not others who, though beaten in the strife, had not fallen so low as he, dispute possession with him of the miserable nourishment to be obtained from the barren land in which he found himself? How could we hope that civilised nations who have to disperse abroad their over-crowded population, would open their arms to unfortunate barbarians? Philanthropy does not reach this point. Are facts in accordance with these forecasts?

History when searched reveals the fall and dispersion of many peoples. To keep closely to the subject which occupies us, we will cite only those tribes which are genuinely savage and have disappeared or are on the point of disappearing. The race of Tasmanians lost their last representative in 1877; an enormous mortality, a very low birth-rate, the difficulties of the surroundings, the cruelty of the colonists, all concurred in causing extinction. Only a small number of the Iroquois and Esquimaux still remains: the savages of the United States diminish daily; in view of their approaching end, and to preserve the remains of their dialect, the various sounds of the words have been noted for the consideration of future students of languages. The Australians, who have already diminished since their acquaintance with alcohol and European corruptions, will only survive foreign invasion a very few years. The end of the Bushmen can also be predicted, and of many of the African races; for the Europeans, in taking possession of Africa, will supplant, and will in no way raise the tribes which inhabit it.

But history does not allow us to doubt that savages still show themselves very apt in returning to a better condition. Certainly we have no evidence that barbarous tribes, remaining where they are, have become civilised. But taken from their surroundings, or when through exceptional circumstances their conditions have been improved, they have shown themselves capable of progress. In the Philippine Islands the Spaniards have raised the level of the Negritos. On the West Coast of New Zealand, the Benedictines proved of what amount of education the Australians were capable.[1] Who does not know the marvels wrought by the Marists in Wallis Island (Oceania), where a thoroughly good education had the effect of making the savages worthy of being raised to the dignity of the Catholic Priesthood? No one now disputes that savages can be civilised. When they have descended to a very low ebb, it is possible that a foreign element may be necessary, not only to make a good environment for them, but also to overcome their apathy.

The example of the Tinneh, which we can quote from M. de Nadaillac,[2] shows to what a position in the march of progress the savage may be incited by a change of circumstances. Thus branches from the Tinneh races went down to South America: and their traces can be found in California, Oregon, and British Columbia. In California, they constitute a fine, strong race under the name of Hupa, remarkable for the domination they exercise over the races already established in the land. The Navajos, who captured Arizona and New Mexico, descended from the Hupas: it was there that the Spaniards encountered them in 1541, where they were cultivating the ground with skill, living in commodious houses, manufacturing silver articles in repoussé work. The religious songs and legends of the Navajos bear witness to their intelligence, while their moral elevation is shown by their respect for women.

[1] Dr Jousset, *Évolution*, p. 201.

[2] De Nadaillac, *Le problème de la vie*, p. 278.

CONCLUSION.

If we bring forward only the data of dogmatic science as evidence, without reference at present to Revelation, we have material with which to sketch in bold outline the history of the human species.

1. At some far distant period of which science cannot determine the date, but which apparently does not exceed 18,000 or 20,000 years, the first human pair appeared on the earth, their nature formed and decided by a superior power—intellectual and personal—whom we call God.

2. The first man whose physical likeness we can only trace in a general manner was endowed with true spiritual intellect and a free will. Being capable of arriving at a knowledge of his soul and of the Author of his being, he must by this fact, have known his duties towards God and towards himself, and have had a consciousness of moral responsibility.

3. We do not mean to say that his science was developed, that he was acquainted with all nature's secrets, that he was able from the beginning to utilise all the physical energy latent in the world. Though created in a simple condition, he was destined for progress. And it is precisely this incessant progress in all the branches of knowledge and industry which makes the striking contrast between the human races and the animal species, which are crystallised into an ever recurring uniformity. Thus man did not become evolved from a state of animality to the condition of a being animated by spirit or mind, but he was endowed with spiritual faculties by his creation, he advances, he evolves, if one prefers the term, towards an ever higher state of civilisation.

4. This civilisation is at first simple. Placed amidst advantageous surroundings, in a spot whose geographical position cannot be decided with certainty, man lived upon the spontaneous fruits of the earth with no difficulty. As mankind increased, it became necessary by cultivation of the

ground, to aid it to produce more abundant harvests, and to hunt the animals which were fit for food with greater activity. On this account, it was found necessary to make implements and weapons. At first, man used only the natural missiles, the uncut stones which he found around him; then he fashioned them in order to give them a more useful shape. It is impossible to say after what lapse of time he became acquainted with metals and discovered their malleability.

5. In proportion, as mankind increased in the primitive centres, and as civilisation rapidly developed, quarrels broke out, caused by inevitable jealousies, and the necessities of the material life. The population becoming too dense, had to disperse. Certain branches of the human family sought for nourishment and peace in more distant parts; whither they carried family traditions and the art of constructing their implements; thus peopling the world. Whilst civilisation continued to progress in the common centres, the wandering tribes making their way into barren countries, had to undergo all the vicissitudes arising from changes of climate, and all the consequences of an itinerant, precarious existence. Some among these emigrants, finding favourable environments, rich in resources, were able to make progress, whilst others thrown upon unproductive lands, endured a life of real degradation.

This picture, which is thoroughly in accordance with prehistoric records and science, seems to reconcile two apparent contradictions, the identity of human nature through all ages, and its unceasing advance towards progress.

Here begins the work of the theologian, who to the light of science unites that of Revelation. On many points on which purely human knowledge hesitates, theology has assured answers; on all the most weighty interests of humanity, it gives us information, that our restricted science would never have discovered. But it is not in accordance with our design to occupy this field. In conclusion, we will only say that primitive man as presented to our apprehension

by competent science, is capable of receiving all communications of a supernatural order, whether of truth or grace, with which it may please the Divine Munificence to enrich him.

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